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A METHOD TO MEASURE THE COAL GAS RELEASE FROM RUN OF THE MINE COAL

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A METHOD TO MEASURE THE COAL GAS RELEASE FROM RUN OF THE MINE COAL

by

D.A. Young*

ABSTRACT

This report presents a method for measuring the coal gas released from run of the mine coal (ROM). The method incorporates the use of a dry test meter and lightweight sample container that can be used in the immediate mining area to measure the amount of coal gas from the ROM. The results of eight field trials, conducted in the mines of the Cape Breton Development Corporation, are used to present a graphical description of these release patterns and to assist in the final discussion.

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MÉTHODE DE MESURE DU DÉGAGEMENT DU GAZ DE HOUILLE DU CHARBON TOUT-VENANT

par

D.A. Young*

RÉSUMÉ

Dans le présent rapport, nous décrivons une méthode de mesure de la quantité de gaz de houille dégagée du charbon tout-venant. La méthode est basée sur l'utilisation d'un compteur de gaz type sec et d'un récipient d'échantillon léger qui peuvent être utilisés à proximité de la zone d'extraction pour mesurer la quantité de gaz de houille dégagée du charbon tout-venant. Les résultats de huit essais sur le terrain, menés dans les mines de la Société de développement du Cap-Breton, sont utilisés pour décrire graphiquement ces modes de dégagement et pour tirer des conclusions.

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INTRODUCTION

The Cape Breton Coal Research Laboratory (CBCRL) Environmental Group is studying the sources of gas emissions into the coal mines of the Cape Breton Development Corporation (CBDC).

Sources of coal gas emissions vary; and some major examples include:

1) Active coalfaces.
2) Over and underlying strata adjacent to the coal seam.
3) The fracturing of coal during extraction and transportation from the mine.
4) Latent sources in gob and previously mined areas.

This report deals with Item 3, the release of coal gas to the mine's ventilation network upon transportation of the coal from the mine. In order to study directly the rate of release of gas from ROM coal, the following parameters must be considered:

1) A sample be retrieved in sufficient quantity and size distribution that is generally representative of the coal being mined.
2) A suitable sample container that provides a gastight seal and is of a size and weight that provides for safe transportation in and out of the mining area.
3) A lightweight gas measuring device that provides continuous and uninterrupted monitoring of coal gas release. It has been found that following mining, normal gas flows from 20-25 kg of CBDC coal is in the 10-100 cc/min range.

The equipment that satisfied the requirements above consists of the following:

1) A Singer Model S6M669846 dry test meter (DTM), Figure 1. This device was tested and found to measure gas flows in the range of 10-100 cc/min. Each of the gas flows are converted to STP (273 K, 760 mm Hg) and corrected against a calibration curve created from

Dry Test Meter

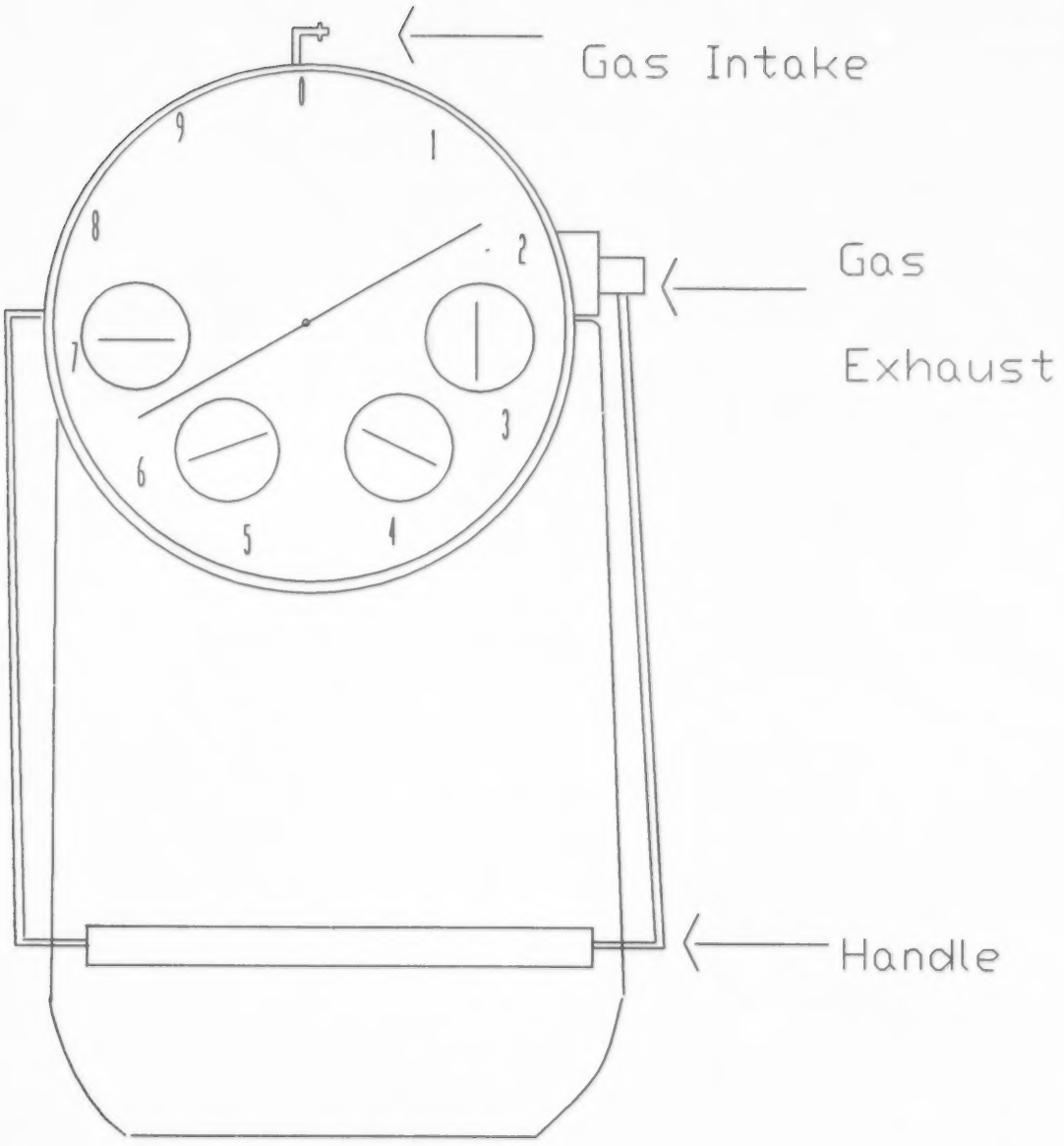


Figure 1 - Singer dry test meter

flow measurements of the DTM vs standardized soap bubble flowmeter (SBF).

2) The sample container selected consists of an IPL Model 5250, 25 l white plastic pail, Figure 2. This container is lightweight (2 kg) and constructed from a high density polyethylene plastic and provides the following:

a) durable construction capable of handling a 25 kg sample of coal.
b) wire handle capable of moving the sample and pail from the site.
c) bladed cover lid capable of providing a gastight seal, Figures 2 and 3. The inner rim incorporates a rubber O-ring that seals the lid to the outer end of the sample pail. The lid is held in place by nine equal distance locks. The sealing process is enhanced by applying a coating of silicone sealant to the outer end of the pail before securing. The sample pail was tested in the laboratory for leak proofness and was found to maintain an effective seal to air pressures of 10 cm of water. Under trial conditions, the maximum pressure observed across the meter has never surpassed .3 cm of water.

Prior to use, the lid is punctured with a 13 mm ID hole. This opening is fitted with a 13 mm OD bored rubber stopper that is fitted with a 9 mm OD two-way plastic tube connector. The pail and meter are connected as in Figure 4 and include a 1.3 cm water sensitive differential gauge for measuring the output pressure of the gas from the sample pail.

SAMPLING AND MEASURING

Mining conditions are never a favourable place to carry out bench type testing; nevertheless, the pail serves to retrieve the sample from the immediate mining area, i.e. wall face, and transport it to a good testing location in the quickest possible time, i.e. with 3 minutes of cutting. The retrieval of the sample is laborious but essential to measure early gas flows.

Sample Pale and Locking Mechanism

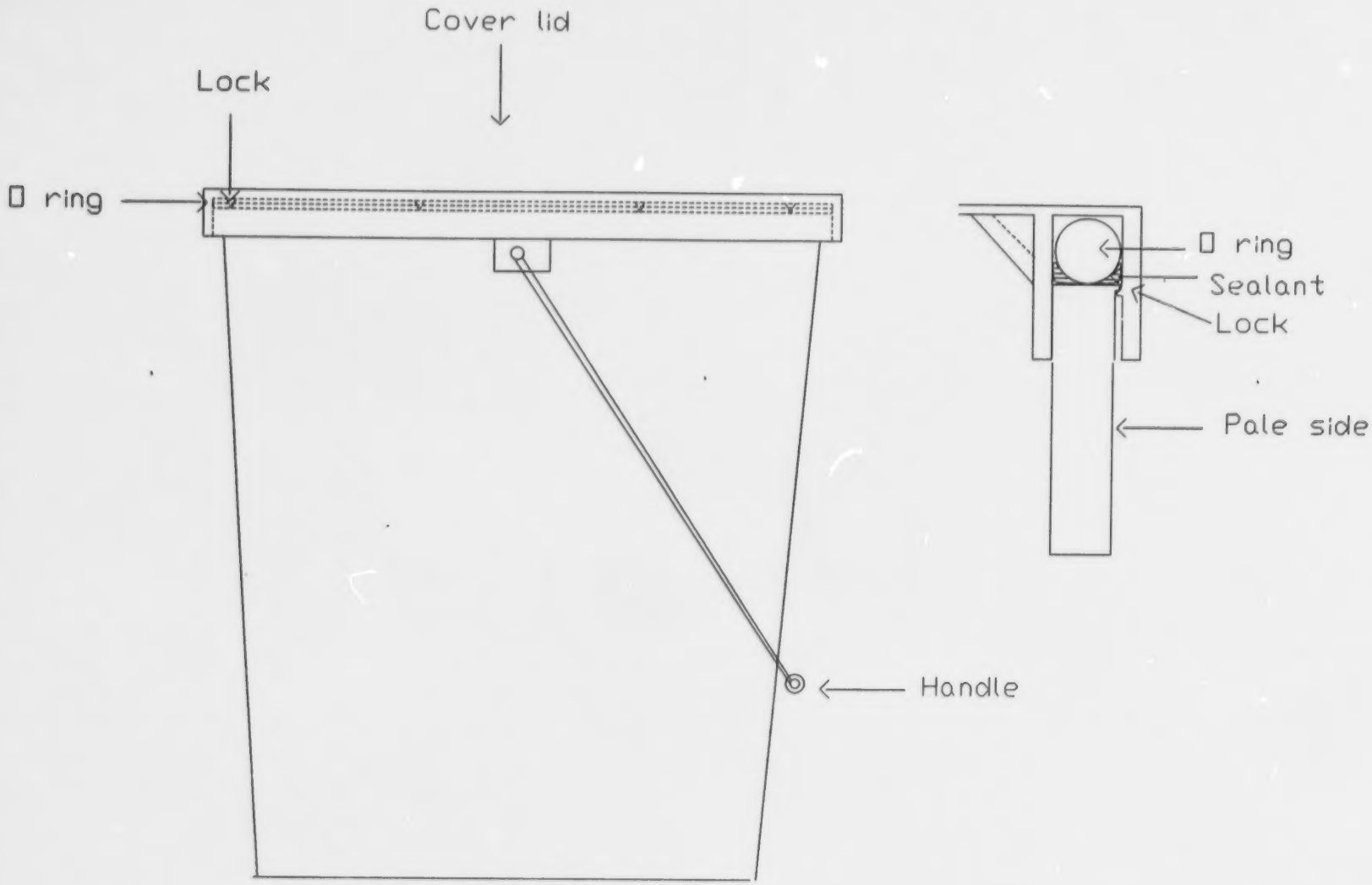


Figure 2 – Sample pail

Cover Lid

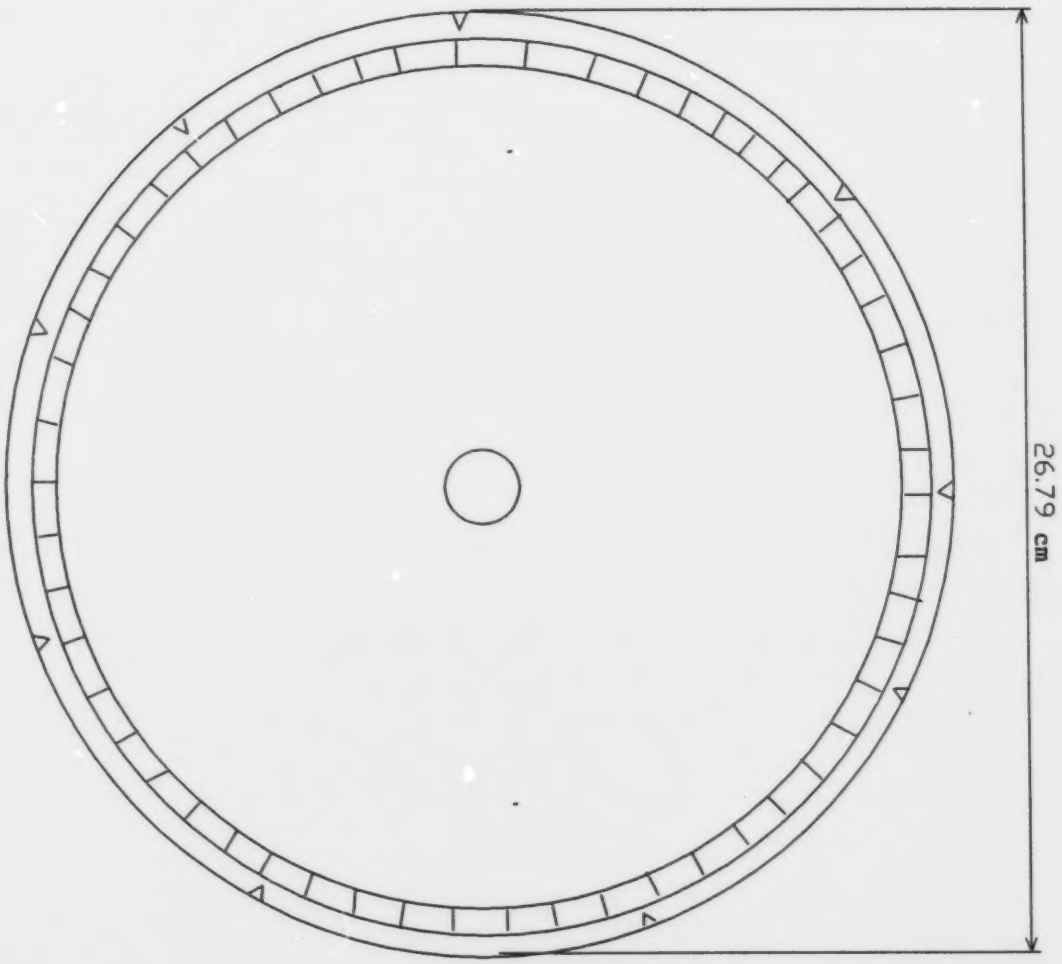
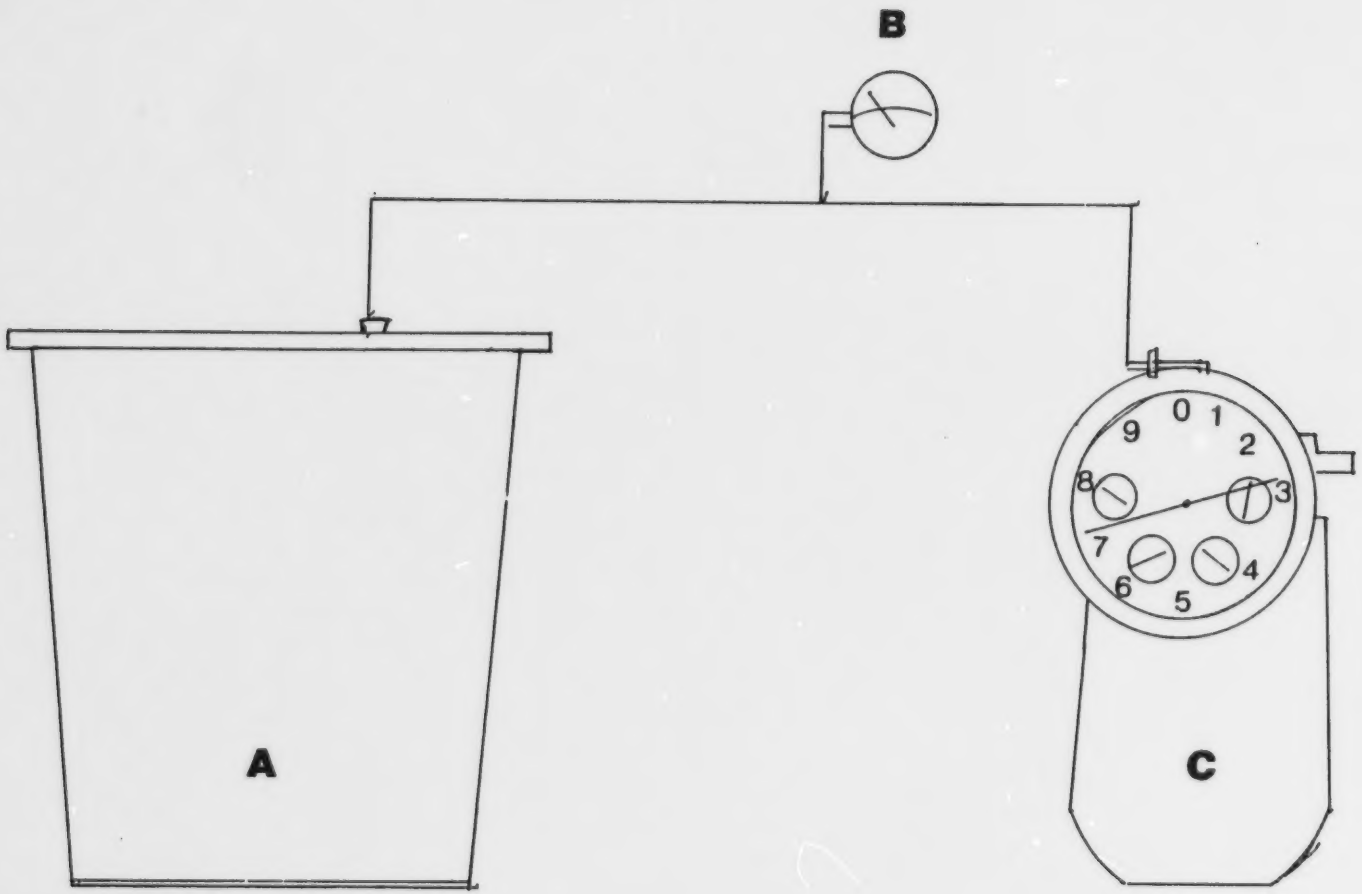


Figure 3 - Cover lid



A Bucket **B Magnenelic** **C DTM.**

Figure 4 - Measuring system assembly

EQUIPMENT

The following equipment is used to retrieve and test a sample of ROM coal:

1) Geological type hammer and pick
2) Silicone sealant
3) Sampling pail and cover lid
4) Large scoop or small shovel
5) Dry test meter
6) .5 in magnehelic pressure gauge
7) 9 mm OD tubing and plastic fittings
8) Stopwatch
9) Spring loaded weighting scale
10) Fitted rubber stopper

PROCEDURE

1) Prepare a testing location in the level or deep, preferably a sitting bench or a flat dry surface outbye the mining area, Figures 5 and 6.
2) Assemble the dry test meter, gauge and connecting tubing before retrieval of the sample.
3) Take items 1 to 4 to the sampling location (mining site).
4) Record the starting time of the mining device taking notice of the coal being removed and its position on the transport system, i.e. panline or conveyor system.
5) Remove a portion of this coal from the stream with the scoop or shovel and place it into the pail and fill to 3/4 capacity.
6) Brush away any coal fines and apply a continuous bead of silicone sealant to the top end of the pail. Press the lid into place and use the hammer to tap and spread the locks within the lid into place.
7) Transport the sample back to the measuring station and connect the rubber stopper into the previously bored hole. Record the inital meter reading, sealing time, air temperature and pressure.

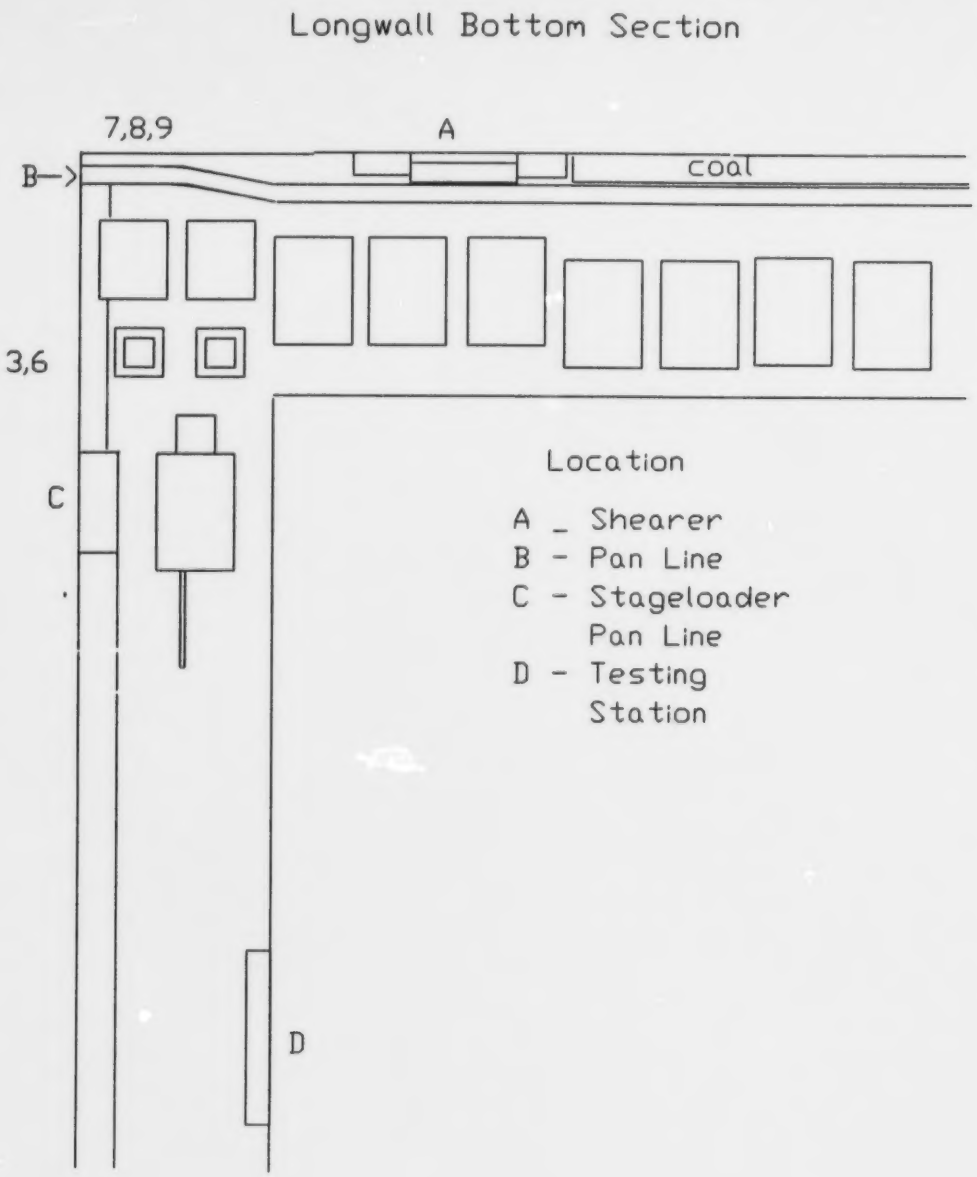


Figure 5 - Longwall bottom section

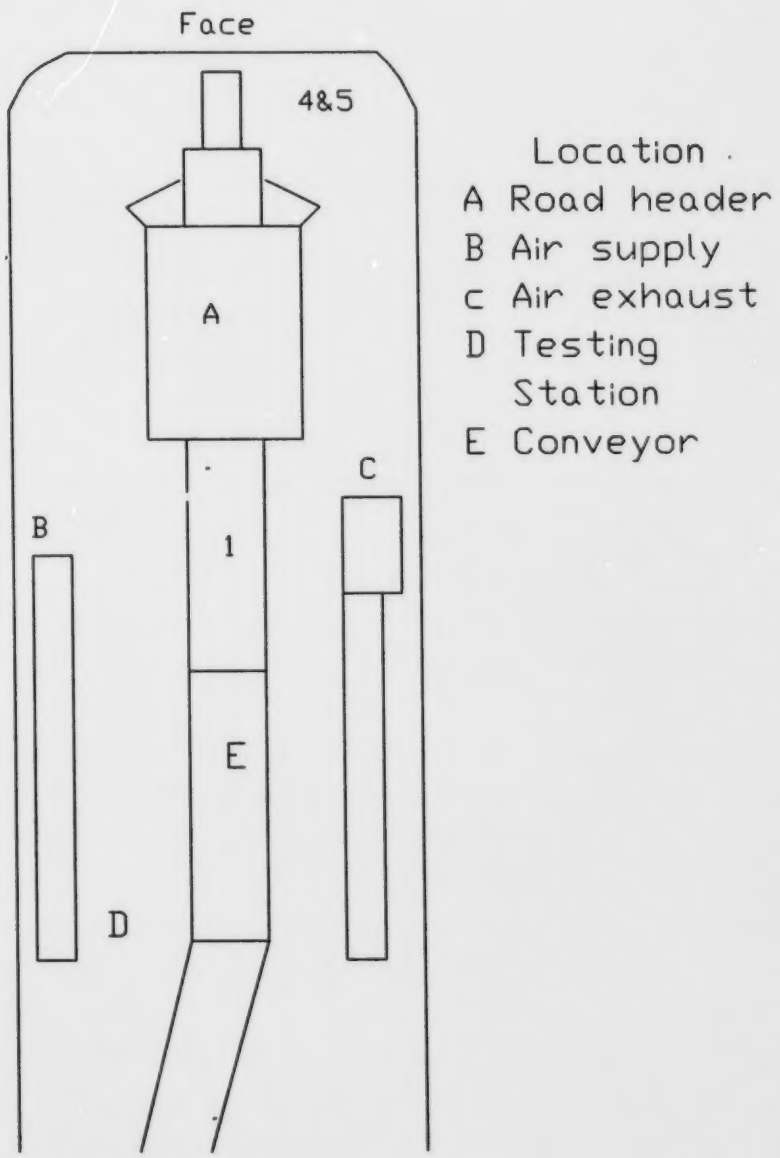


Figure 6 - Development heading

8) Record the meter reading, air temperature and pressure at 1 or 2 minute intervals. Continue this monitoring to the desired time of interest.

9) When monitoring is finished, disconnect the tubing. At this point, the sample in whole may be taken to the surface or a portion split from the main sample underground. If a portion is to be taken back, then use a calibrated spring loaded scale to give a total sample weight for future compilations.

SUMMARY OF FIELD TRIALS

The following is a summary of the conditions at the sampling location during the eight trials carried out by CBCRL using the above apparatus and procedures. Tables 1 to 9 provide location and site condition information along with compilation of the data and presentation of results.

The summaries also make reference to each table respectively. Figures 5 and 6 make reference to the sampling sites using the pail # as an identifier:

Pail #1 - This trial took place at the Phalen Mine 3 Deep development heading, Figure 6, with the cutting of coal on a regular basis. Conditions at the face area were wet as represented in the moisture content of the sample, Table 1. Due to the conditions at the face the sample was retrieved from the conveyor system of the mining machine.

Pail #2 - This trial took place at Lingan Mine's bunker located in 3 Deep. The bunker is an underground coal storage location and a common point for coal transfer out of the mine. The bunker area is equipped with heavy belt water sprays that wet the coal and this results in the high moisture content of the coal sample, Table 2.

Table 1 - Field trial for pail #1

Mine Phalen
Location 3 Deep developement
Sample ID Pail #1
Date 10/02/86

Moisture % 1.57
Ash % 15.6
Factor (f) .8283
Sample Mass (grms)(m) 21460
Mining Time 09:42:00
Sealing Time 09:43:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM READING L	F Gas Vol cc	G Vol cc STP	H Flow cc/Min (G/L)	I Corrected Flow cc Min	J CH4 M3/Ton (L*I)/(m*f)	K Cumulative M3/Ton	L Time increment Min	M Cumulative Time Min
10/02/86	09:43:00	Initial reading->		47.050			Estimated value->		0.0252	0.0252	1.00	1.00
10/02/86	09:44:00	18.5	794.5	47.239	189.0	169	169	172	0.0097	0.0349	1.00	2.00
10/02/86	09:45:00	18.5	794.5	47.380	141.0	126	126	128	0.0072	0.0421	1.00	3.00
10/02/86	09:46:00	18.5	794.5	47.487	107.0	96	96	97	0.0055	0.0475	1.00	4.00
10/02/86	09:47:00	18.5	794.5	47.595	108.0	97	97	98	0.0055	0.0531	1.00	5.00
10/02/86	09:48:00	18.5	794.5	47.700	105.0	94	94	95	0.0054	0.0584	1.00	6.00
10/02/86	09:49:00	18.5	794.5	47.816	116.0	104	104	105	0.0059	0.0644	1.00	7.00
10/02/86	09:50:00	18.5	794.5	47.913	97.0	87	87	88	0.0050	0.0693	1.00	8.00
10/02/86	09:51:00	18.0	794.5	47.980	67.0	60	60	61	0.0034	0.0728	1.00	9.00
10/02/86	09:52:00	18.0	794.5	48.050	70.0	63	63	64	0.0036	0.0763	1.00	10.00
10/02/86	09:53:00	18.0	794.5	48.130	80.0	72	72	73	0.0041	0.0804	1.00	11.00
10/02/86	09:54:00	18.0	794.5	48.202	72.0	65	65	66	0.0037	0.0841	1.00	12.00
10/02/86	09:55:00	18.0	794.5	48.289	87.0	78	78	79	0.0045	0.0886	1.00	13.00
10/02/86	09:56:00	18.0	794.5	48.379	90.0	81	81	82	0.0046	0.0932	1.00	14.00
10/02/86	09:57:00	18.0	794.5	48.454	75.0	67	67	68	0.0038	0.0970	1.00	15.00
10/02/86	10:00:00	19.1	794.5	48.667	213.0	190	63	64	0.0109	0.1079	3.00	18.00
10/02/86	10:03:00	19.1	794.5	48.914	247.0	221	74	75	0.0126	0.1205	3.00	21.00
10/02/86	10:06:00	19.1	794.5	49.150	236.0	211	70	71	0.0120	0.1325	3.00	24.00
10/02/86	10:09:00	19.1	794.5	49.322	172.0	154	51	52	0.0088	0.1413	3.00	27.00
10/02/86	10:12:00	19.1	794.5	49.483	161.0	144	48	49	0.0082	0.1495	3.00	30.00
10/02/86	10:15:00	19.1	794.5	49.654	171.0	153	51	52	0.0087	0.1583	3.00	33.00
10/02/86	10:18:00	18.2	794.5	49.777	123.0	110	37	37	0.0063	0.1646	3.00	36.00

Table 1 - Continued

Mine	Phalen	Moisture %	1.57
Location	3 Deep developement	Ash %	15.6
Sample ID	Pail #1	Factor (f)	.8283
Date	10/02/86	Sample Mass (grms)(m)	21460
		Mining Time	09:42:00
		Sealing Time	09:43:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM READING L	F Gas Vol cc	G Vol cc STP	H Flow cc/Min (G/L)	I Corrected Flow cc Min	J CH4 M3/Ton (L*I)/(m*f)	K Cumulative M3/Ton	L Time increment Min	M Cumulative Time Min
10/02/86	10:21:00	18.5	794.5	49.891	114.0	102	34	35	0.0058	0.1704	3.00	39.00
10/02/86	10:24:00	18.0	794.5	50.014	123.0	110	37	37	0.0063	0.1767	3.00	42.00
10/02/86	10:27:00	18.0	794.5	50.169	155.0	139	46	47	0.0079	0.1847	3.00	45.00
10/02/86	10:30:00	18.0	794.5	50.280	111.0	100	33	34	0.0057	0.1904	3.00	48.00
10/02/86	10:33:00	19.0	795.0	50.409	129.0	115	38	39	0.0066	0.1970	3.00	51.00
10/02/86	10:36:00	19.0	795.0	50.538	129.0	115	38	39	0.0066	0.2035	3.00	54.00
10/02/86	10:39:00	18.5	795.0	50.679	141.0	126	42	43	0.0072	0.2108	3.00	57.00
10/02/86	10:42:00	18.1	795.0	50.838	159.0	143	48	48	0.0081	0.2189	3.00	60.00
10/02/86	10:45:00	18.1	795.0	50.952	114.0	102	34	35	0.0058	0.2247	3.00	63.00

Table 2 - Field trial for pail #2

Mine Lingan
Location Bunker
Sample ID Pail #2
Date 11/06/86

Moisture % 7.6
Ash % 24.8
Sample Mass (grms)(m) 22918
Factor (f) 0.676
Sealing Time 09:46:00
Mining Time NA

A Date	B Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G Vol cc STP	H Flow cc/Min (G/L)	I Corrected Flow cc/Min	J CH4 M3/Ton (L*I)/(m*f)	K Cumulative M3/Ton	L Time Increment Min	M Cumulative Time Min
11/06/86	09:47:00	Initial reading->		174.037			Estimated value->		0.0169	0.0169	1.00	1.00
11/06/86	09:50:00	17.10	823	174.235	198	172	96	97	0.0188	0.0296	3.00	4.00
11/06/86	09:53:00	17.10	823	174.378	143	124	73	74	0.0143	0.0393	3.00	7.00
11/06/86	09:56:00	17.00	823	174.495	117	102	60	60	0.0117	0.0472	3.00	10.00
11/06/86	09:59:00	17.00	823	174.588	93	81	47	48	0.0093	0.0535	3.00	13.00
11/06/86	10:02:00	17.00	826	174.675	87	75	44	45	0.0087	0.0593	3.00	16.00
11/06/86	10:05:00	17.10	826	174.761	86	75	44	44	0.0086	0.0651	3.00	19.00
11/06/86	10:08:00	17.00	826	174.855	94	81	48	48	0.0094	0.0715	3.00	22.00
11/06/86	10:11:00	17.00	826	174.964	109	94	55	56	0.0109	0.0788	3.00	25.00
11/06/86	10:14:00	17.00	826	175.053	89	77	45	46	0.0089	0.0848	3.00	28.00
11/06/86	10:17:00	17.00	826	175.151	98	85	50	50	0.0098	0.0914	3.00	31.00
11/06/86	10:20:00	17.00	826	175.250	99	86	50	51	0.0099	0.0981	3.00	34.00
11/06/86	10:23:00	17.00	826	175.345	95	82	48	49	0.0095	0.1045	3.00	37.00
11/06/86	10:26:00	17.00	826	175.423	78	68	40	40	0.0078	0.1098	3.00	40.00
11/06/86	10:29:00	17.00	826	175.489	66	57	33	34	0.0066	0.1142	3.00	43.00
11/06/86	10:32:00	16.90	826	175.545	56	49	28	29	0.0056	0.1180	3.00	46.00
11/06/86	10:35:00	16.90	826	175.616	71	62	36	37	0.0071	0.1228	3.00	49.00
11/06/86	10:38:00	16.90	826	175.682	66	57	33	34	0.0066	0.1272	3.00	52.00
11/06/86	10:41:00	16.90	826	175.765	83	72	42	43	0.0083	0.1328	3.00	55.00
11/06/86	10:44:00	16.90	826	175.850	85	74	43	44	0.0085	0.1385	3.00	58.00
11/06/86	10:45:00	16.90	826	175.876	26	23	40	40	0.0026	0.1403	1.00	59.00

Table 3 - Field trial for pail #3

Mine	Lingan	Moisture %	4.9
Location	6 West Bottom	Ash %	21.31
Sample ID	Pail #3	Sample Mass (grms)(m)	18643
Date	11/13/86	Factor (f)	0.7379
		Mining Time	10:15:00
		Sealing Time	10:18:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G Vol cc STP	H Flow cc/min (G/L)	I Corrected Flow cc Min	J CH4 M3/Ton (L*I)/(m*f)	K Cumulative M3/Ton	L Time Increment Min	M Cumulative Time Min
11/14/86	10:18:00	Initial Reading->		189.675			Estimated value ->		0.0849	0.0849	3.00	3.00
11/14/86	10:19:00	24.00	808	189.722	47	41	41	41	0.0030	0.0879	1.00	4.00
11/14/86	10:21:00	24.00	808	189.812	90	78	39	40	0.0113	0.0992	2.00	6.00
11/14/86	10:25:00	24.00	808	189.932	120	104	26	26	0.0302	0.1293	4.00	10.00
11/14/86	10:28:00	24.00	808	190.050	118	102	34	35	0.0223	0.1516	3.00	13.00
11/14/86	10:31:00	24.00	808	190.149	99	86	29	29	0.0187	0.1703	3.00	16.00
11/14/86	10:34:00	24.00	808	190.220	71	61	20	21	0.0134	0.1837	3.00	19.00
11/14/86	10:37:00	24.00	808	190.286	66	57	19	19	0.0124	0.1961	3.00	22.00
11/14/86	10:40:00	23.90	808	190.355	69	60	20	20	0.0130	0.2091	3.00	25.00
11/14/86	10:43:00	23.90	808	190.438	83	72	24	24	0.0157	0.2248	3.00	28.00
11/14/86	10:46:00	23.90	808	190.525	87	75	25	26	0.0164	0.2412	3.00	31.00
11/14/86	10:49:00	23.90	808	190.609	84	73	24	25	0.0158	0.2571	3.00	34.00
11/14/86	10:52:00	23.90	808	190.678	69	60	20	20	0.0130	0.2701	3.00	37.00
11/14/86	10:55:00	23.90	808	190.741	63	55	18	19	0.0119	0.2820	3.00	40.00
11/14/86	10:58:00	23.90	808	190.831	90	78	26	26	0.0170	0.2989	3.00	43.00
11/14/86	11:01:00	23.90	808	190.897	66	57	19	19	0.0125	0.3114	3.00	46.00
11/14/86	11:04:00	23.90	808	190.972	75	65	22	22	0.0142	0.3255	3.00	49.00
11/14/86	11:08:00	23.20	808	191.069	97	84	21	21	0.0245	0.3500	4.00	53.00
11/14/86	11:10:00	23.20	808	191.109	40	35	17	18	0.0050	0.3551	2.00	55.00
11/14/86	11:13:00	23.20	808	191.168	59	51	17	17	0.0112	0.3662	3.00	58.00
11/14/86	11:16:00	23.20	808	191.226	58	50	17	17	0.0110	0.3772	3.00	61.00
11/14/86	11:19:00	23.20	808	191.284	58	50	17	17	0.0110	0.3881	3.00	64.00

Table 3 - Continued

Mine Lingan
Location 6 West Bottom
Sample ID Pail #3
Date 11/13/86

Moisture % 4.9
Ash % 21.31
Sample Mass (grms)(m) 18643
Factor (f) 0.7379
Mining Time 10:15:00
Sealing Time 10:18:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G Vol cc STP	H Flow cc/min (G/L)	I Corrected Flow cc Min	J CH4 M3/Ton (L*I)/(m*f)	K Cumulative M3/Ton	L Time Increment Min	M Cumulative Time Min
11/14/86	11:22:00	23.20	808	191.338	54	47	16	16	0.0102	0.3984	3.00	67.00
11/14/86	11:25:00	23.20	808	191.371	33	29	10	10	0.0062	0.4046	3.00	70.00
11/14/86	11:28:00	23.30	808	191.416	45	39	13	13	0.0085	0.4131	3.00	73.00
11/14/86	11:31:00	23.30	808	191.455	39	34	11	12	0.0074	0.4205	3.00	76.00
11/14/86	11:34:00	23.30	808	191.492	37	32	11	11	0.0070	0.4275	3.00	79.00
11/14/86	11:37:00	23.30	808	191.527	35	30	10	10	0.0066	0.4341	3.00	82.00
11/14/86	11:40:00	23.30	808	191.560	33	29	10	10	0.0062	0.4403	3.00	85.00
11/14/86	11:43:00	23.30	808	191.600	40	35	12	12	0.0076	0.4479	3.00	88.00
11/14/86	11:46:00	23.30	808	191.637	37	32	11	11	0.0070	0.4549	3.00	91.00
11/14/86	11:49:00	23.30	808	191.672	35	30	10	10	0.0066	0.4615	3.00	94.00
11/14/86	11:52:00	23.30	808	191.710	38	33	11	11	0.0072	0.4687	3.00	97.00
11/14/86	11:55:00	23.30	808	191.748	38	33	11	11	0.0072	0.4759	3.00	100.00
11/14/86	11:59:00	23.30	808	191.802	54	47	12	12	0.0136	0.4895	4.00	104.00
11/14/86	12:01:00	23.30	808	191.821	19	16	8	8	0.0024	0.4919	2.00	106.00
11/14/86	12:04:00	23.30	808	191.851	30	26	9	9	0.0057	0.4976	3.00	109.00

Table 4 - Field trial for pail #'s 4 and 5

Mine Phalen
Location 1 east developement
Sample IDPail #4&5
Date 12/05/86

Moisture % 1.09
Ash % 6.2
Sample Mass (grms)(m) 28970
Factor (f) 0.9271
Mininig Time 10:08:00
Sealing Time 10:10:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G Vol cc STp	H Flow cc/Min (G/L)	I Corrected Flow cc/Min	J CH4 M3/Ton (L*I)/(m*f)	K Cumulative M3/Ton	L Time Increment Min	M Cumulative Time Min
12/05/86	10:10:00	Initial reading->		194.820			Estimated value->		0.0177	0.0177	2	2
12/05/86	10:12:00	17.5	776	194.945	125	115	58	58	0.0043	0.0220	2	4
12/05/86	10:14:00	17.8	776	195.089	144	132	66	67	0.0050	0.0270	2	6
12/05/86	10:16:00	18.0	776	195.185	96	88	44	45	0.0033	0.0304	2	8
12/05/86	10:18:00	18.2	776	195.300	115	106	53	54	0.0040	0.0344	2	10
12/05/86	10:20:00	18.5	776	195.410	110	101	50	51	0.0038	0.0382	2	12
12/05/86	10:22:00	18.1	776	195.472	62	57	28	29	0.0022	0.0403	2	14
12/05/86	10:24:00	18.2	776	195.527	55	50	25	26	0.0019	0.0422	2	16
12/05/86	10:26:00	18.2	776	195.579	52	48	24	24	0.0018	0.0440	2	18
12/05/86	10:28:00	19.0	776	195.627	48	44	22	22	0.0017	0.0457	2	20
12/05/86	10:30:00	19.0	776	195.664	37	34	17	17	0.0013	0.0470	2	22
12/05/86	10:32:00	18.6	776	195.699	35	32	16	16	0.0012	0.0482	2	24
12/05/86	10:34:00	18.5	776	195.731	32	29	15	15	0.0011	0.0493	2	26
12/05/86	10:36:00	18.6	776	195.757	26	24	12	12	0.0009	0.0502	2	28
12/05/86	10:38:00	18.6	776	195.776	19	17	9	9	0.0007	0.0509	2	30
12/05/86	10:40:00	18.7	776	195.796	20	18	9	9	0.0007	0.0516	2	32
12/05/86	10:42:00	18.7	776	195.828	32	29	15	15	0.0011	0.0527	2	34
12/05/86	10:44:00	18.7	776	195.858	30	27	14	14	0.0010	0.0537	2	36
12/05/86	10:46:00	18.7	776	195.890	32	29	15	15	0.0011	0.0549	2	38
12/05/86	10:48:00	18.5	776	195.919	29	27	13	14	0.0010	0.0559	2	40
12/05/86	10:50:00	18.2	776	195.948	29	27	13	14	0.0010	0.0569	2	42
12/05/86	10:52:00	18.2	776	195.975	27	25	12	13	0.0009	0.0578	2	44

Table 4 - Continued

Mine Phalen
Location 1 east developement
Sample IDPail #485
Date 12/05/86

Moisture % 1.09
Ash % 6.2
Sample Mass (grms)(m) 28970
Factor (f) 0.9271
Mininig Time 10:08:00
Sealing Time 10:10:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTN Reading L	F Gas Vol cc	G Vol cc STp	H Flow cc/Min (G/L)	I Corrected Flow cc/Min	J CH4 M3/Ton (L*I)/(m*f)	K Cumulative M3/Ton	L Time Increment Min	M Cumulative Time Min
12/05/86	10:54:00	17.9	776	196.002	27	25	12	13	0.0009	0.0588	2	46
12/05/86	10:56:00	15.5	776	196.028	26	24	12	12	0.0009	0.0597	2	48
12/05/86	11:35:00	15.5	776	195.670			Estimated value->		0.0603	0.1200	39	87
12/05/86	11:45:00	16.0	776	195.780	110	102	10	10	0.0039	0.1239	10	97
12/05/86	11:55:00	15.5	776	195.885	105	97	10	10	0.0037	0.1276	10	107
12/05/86	12:05:00	15.5	775	195.979	94	87	9	9	0.0033	0.1309	10	117
12/05/86	12:10:00	16.0	775	196.023	44	41	8	8	0.0016	0.1325	5	122
12/05/86	12:15:00	16.1	775	196.070	47	44	9	9	0.0017	0.1341	5	127
12/05/86	12:20:00	16.0	776	196.120	50	46	9	9	0.0018	0.1359	5	132
12/05/86	12:25:00	16.0	776	196.172	52	48	10	10	0.0018	0.1377	5	137
12/05/86	12:30:00	13.8	776	196.219	47	44	9	9	0.0017	0.1394	5	142
12/05/86	12:35:00	14.5	776	196.268	49	46	9	9	0.0017	0.1411	5	147
12/05/86	12:38:00	14.5	776	196.379	111	103	34	35	0.0039	0.1450	3	150

Table 5 - Field trial for pail #6

Mine Lingan
Location 6 West bottom
Sampling Pail #6
Date 01/22/87

Moisture % 0.66
Ash % 9.78
Sample Mass (grms)(m) 18824
Factor (f) 0.8956
Mining Time 10:29:00
Sealing Time 10:31:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G Vol cc STP	H Flow cc/Min G/L	I Corrected Flow cc/Min	J CH4 M3/Ton (L*I)/(m*f)	K Cumulative M3/Ton	L Time Increment Min	M Cumulative Time Min
01/22/87	10:31:00	Initial reading->		38.309			Estimated value->		0.0113	0.0113	2.00	2.00
01/22/87	10:32:00	21.00	814	38.355	46	40	40	41	0.0024	0.0137	1.00	3.00
01/22/87	10:33:00	21.00	814	38.380	25	22	22	22	0.0013	0.0150	1.00	4.00
01/22/87	10:34:00	21.00	814	38.402	22	19	19	19	0.0012	0.0162	1.00	5.00
01/22/87	10:35:00	21.00	814	38.433	31	27	27	27	0.0016	0.0178	1.00	6.00
01/22/87	10:36:00	21.00	814	38.469	36	31	31	32	0.0019	0.0197	1.00	7.00
01/22/87	10:37:00	21.00	814	38.487	18	16	16	16	0.0009	0.0206	1.00	8.00
01/22/87	10:38:00	21.00	814	38.511	24	21	21	21	0.0013	0.0219	1.00	9.00
01/22/87	10:39:00	21.00	814	38.534	23	20	20	20	0.0012	0.0231	1.00	10.00
01/22/87	10:40:00	21.00	814	38.564	30	26	26	26	0.0016	0.0247	1.00	11.00
01/22/87	10:41:00	21.00	814	38.610	46	40	40	41	0.0024	0.0271	1.00	12.00
01/22/87	10:43:00	21.00	814	38.649	39	34	17	17	0.0020	0.0291	2.00	14.00
01/22/87	10:45:00	21.00	814	38.682	33	29	14	15	0.0017	0.0308	2.00	16.00
01/22/87	10:47:00	21.10	814	38.721	39	34	17	17	0.0020	0.0329	2.00	18.00
01/22/87	10:49:00	21.10	814	38.760	39	34	17	17	0.0020	0.0349	2.00	20.00
01/22/87	10:51:00	21.10	814	38.800	40	35	17	18	0.0021	0.0370	2.00	22.00
01/22/87	10:53:00	21.10	814	38.840	40	35	17	18	0.0021	0.0391	2.00	24.00
01/22/87	10:55:00	21.10	815	38.880	40	35	17	18	0.0021	0.0412	2.00	26.00
01/22/87	10:57:00	21.00	815	38.922	42	36	18	19	0.0022	0.0434	2.00	28.00
01/22/87	10:59:00	21.00	815	38.944	22	19	10	10	0.0012	0.0446	2.00	30.00
01/22/87	11:00:00	21.00	815	38.990	46	40	40	40	0.0024	0.0470	1.00	31.00
01/22/87	11:02:00	21.00	815	39.031	41	36	18	18	0.0021	0.0491	2.00	33.00

Table 5 - Continued

Mine Lingan
Location 6 West bottom
Sampling Pail #6
Date 01/22/87

Moisture % 0.66
Ash % 9.78
Sample Mass (grms)(m) 18824
Factor (f) 0.8956
Mining Time 10:29:00
Sealing Time 10:31:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G Vol cc STP	H Flow cc/Min G/L	I Corrected Flow cc/Min	J CH4 M3/Ton (L*I)/(m*f)	K Cumulative M3/Ton	L Time Increment Min	M Cumulative Time Min
01/22/87	11:04:00	21.00	815	39.074	43	37	19	19	0.0023	0.0514	2.00	35.00
01/22/87	11:06:00	21.00	815	39.112	38	33	16	17	0.0020	0.0533	2.00	37.00
01/22/87	11:08:00	21.10	815	39.152	40	35	17	18	0.0021	0.0554	2.00	39.00
01/22/87	11:10:00	21.10	815	39.185	33	29	14	15	0.0017	0.0572	2.00	41.00
01/22/87	11:12:00	21.10	815	39.228	43	37	19	19	0.0023	0.0594	2.00	43.00
01/22/87	11:14:00	21.10	815	39.272	44	38	19	19	0.0023	0.0617	2.00	45.00
01/22/87	11:17:00	21.10	815	39.32	48	42	14	14	0.0025	0.0642	3.00	48.00
01/22/87	11:19:00	21.10	815	39.339	19	16	8	8	0.0010	0.0652	2.00	50.00
01/22/87	11:20:00	21.10	815	39.361	22	19	19	19	0.0012	0.0664	1.00	51.00
01/22/87	11:22:00	21.10	815	39.391	30	26	13	13	0.0016	0.0680	2.00	53.00
01/22/87	11:24:00	21.10	815	39.420	29	25	13	13	0.0015	0.0695	2.00	55.00
01/22/87	11:26:00	21.10	815	39.446	26	23	11	12	0.0014	0.0709	2.00	57.00
01/22/87	11:28:00	21.10	815	39.471	25	22	11	11	0.0013	0.0722	2.00	59.00
01/22/87	11:30:00	21.10	815	39.494	23	20	10	10	0.0012	0.0734	2.00	61.00
01/22/87	11:32:00	21.10	815	39.528	34	29	15	15	0.0018	0.0752	2.00	63.00
01/22/87	11:35:00	21.10	815	39.560	32	28	9	9	0.0017	0.0768	3.00	66.00
01/22/87	11:38:00	21.10	815	39.599	39	34	11	12	0.0020	0.0789	3.00	69.00
01/22/87	11:41:00	21.10	815	39.645	46	40	13	14	0.0024	0.0813	3.00	72.00
01/22/87	11:45:00	21.10	815	39.681	36	31	8	8	0.0019	0.0832	4.00	76.00
01/22/87	11:48:00	21.10	815	39.72	39	34	11	12	0.0020	0.0853	3.00	79.00
01/22/87	11:51:00	21.10	815	39.770	50	43	14	15	0.0026	0.0879	3.00	82.00
01/22/87	11:54:00	21.10	815	39.809	39	34	11	12	0.0020	0.0899	3.00	85.00

Table 5 - Continued

Mine Lingan
Location 6 West bottom
Sampling Pail #6
Date 01/22/87

Moisture % 0.66
Ash % 9.78
Sample Mass (grms)(m) 18824
Factor (f) 0.8956
Mining Time 10:29:00
Sealing Time 10:31:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G Vol cc STP	H Flow cc/Min G/L	I Corrected Flow cc/Min	J CH4 M3/Ton (L*I)/(m*f)	K Cumulative M3/Ton	L Time Increment Min	M Cumulative Time Min
01/22/87	11:57:00	21.10	815	39.841	32	28	9	9	0.0017	0.0916	3.00	88.00
01/22/87	12:00:00	21.10	815	39.870	29	25	8	9	0.0015	0.0931	3.00	91.00
01/22/87	12:03:00	21.10	815	39.903	33	29	10	10	0.0017	0.0949	3.00	94.00
01/22/87	12:06:00	21.10	815	39.940	37	32	11	11	0.0019	0.0968	3.00	97.00
01/22/87	12:09:00	21.10	815	39.969	29	25	8	9	0.0015	0.0983	3.00	100.00
01/22/87	12:12:00	21.10	815	39.992	23	20	7	7	0.0012	0.0996	3.00	103.00
01/22/87	12:15:00	21.10	815	40.012	20	17	6	6	0.0011	0.1006	3.00	106.00
01/22/87	12:18:00	21.10	815	40.049	37	32	11	11	0.0019	0.1026	3.00	109.00
01/22/87	12:22:00	21.10	815	40.070	21	18	5	5	0.0011	0.1037	4.00	113.00
01/22/87	12:24:00	21.10	815	40.099	29	25	13	13	0.0015	0.1052	2.00	115.00
01/22/87	12:27:00	21.10	815	40.121	22	19	6	7	0.0012	0.1064	3.00	118.00
01/22/87	12:30:00	21.10	815	40.138	17	15	5	5	0.0009	0.1073	3.00	121.00
01/22/87	12:32:00	21.10	815	40.169	31	27	13	14	0.0016	0.1089	2.00	123.00
01/22/87	12:35:00	21.10	815	40.195	26	23	8	8	0.0014	0.1103	3.00	126.00
01/22/87	12:38:00	21.10	815	40.221	26	23	8	8	0.0014	0.1116	3.00	129.00
01/22/87	12:41:00	21.10	815	40.253	32	28	9	9	0.0017	0.1133	3.00	132.00
01/22/87	12:44:00	21.10	815	40.286	33	29	10	10	0.0017	0.1151	3.00	135.00
01/22/87	12:47:00	21.10	815	40.314	28	24	8	8	0.0015	0.1165	3.00	138.00
01/22/87	12:50:00	21.10	815	40.35	36	31	10	11	0.0019	0.1184	3.00	141.00
01/22/87	12:53:00	21.10	815	40.38	30	26	9	9	0.0016	0.1200	3.00	144.00
01/22/87	12:56:00	21.10	815	40.41	30	26	9	9	0.0016	0.1216	3.00	147.00
01/22/87	12:59:00	21.10	815	40.451	41	36	12	12	0.0022	0.1237	3.00	150.00

Table 6 - Field trial for pail #7

Mine Lingan
Location 10 East Bottom
Sample ID Pail #7
Date 01/28/87

Moisture % 1.06
Ash % 4.43
Sample Mass (grms)(m) 18643
Factor (f) 0.9451
Mining Time 05:31:30
Sealing Time 05:33:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G Vol cc STP	H Flow cc/Min (G/L)	I Corrected Flow cc/Min	J CH4 M3/Ton (L*I)/(m*f)	K Cumulative M3/Ton	L Time Increment min	M Cumulative Time Min
01/28/87	05:33:00	Initial reading->		41.265			Estimated Value->		0.0320	0.0320	1.50	1.50
01/28/87	05:34:30	19.00	805	41.390	125	110	74	75	0.0064	0.0384	1.50	3.00
01/28/87	05:36:00	19.00	805	41.535	145	128	85	87	0.0074	0.0457	1.50	4.50
01/28/87	05:39:00	19.00	805	41.755	220	194	65	66	0.0112	0.0569	3.00	7.50
01/28/87	05:40:00	19.00	805	41.845	90	79	79	81	0.0046	0.0615	1.00	8.50
01/28/87	05:41:00	19.00	805	41.940	95	84	84	85	0.0048	0.0663	1.00	9.50
01/28/87	05:42:00	19.00	805	42.061	121	107	107	108	0.0061	0.0724	1.00	10.50
01/28/87	05:43:00	19.00	805	42.170	109	96	96	98	0.0055	0.0780	1.00	11.50
01/28/87	05:44:00	19.00	805	42.260	90	79	79	81	0.0046	0.0825	1.00	12.50
01/28/87	05:45:00	19.00	805	42.342	82	72	72	73	0.0042	0.0867	1.00	13.50
01/28/87	05:46:00	19.00	805	42.440	98	86	86	88	0.0050	0.0917	1.00	14.50
01/28/87	05:47:00	19.00	805	42.531	91	80	80	81	0.0046	0.0963	1.00	15.50
01/28/87	05:48:00	19.00	805	42.625	94	83	83	84	0.0048	0.1011	1.00	16.50
01/28/87	05:49:00	19.00	805	42.712	87	77	77	78	0.0044	0.1055	1.00	17.50
01/28/87	05:50:00	19.00	805	42.801	89	79	79	80	0.0045	0.1100	1.00	18.50
01/28/87	05:51:00	19.00	805	42.885	84	74	74	75	0.0043	0.1143	1.00	19.50
01/28/87	05:52:00	19.00	805	42.950	65	57	57	58	0.0033	0.1176	1.00	20.50
01/28/87	05:53:00	19.00	805	43.020	70	62	62	63	0.0036	0.1212	1.00	21.50
01/28/87	05:55:00	19.00	805	43.128	108	95	48	48	0.0055	0.1267	2.00	23.50
01/28/87	05:56:00	19.00	805	43.189	61	54	54	55	0.0031	0.1298	1.00	24.50
01/28/87	05:58:00	19.00	805	43.315	126	111	56	56	0.0064	0.1362	2.00	26.50
01/28/87	05:59:00	19.00	805	43.375	60	53	53	54	0.0031	0.1392	1.00	27.50

Table 6 - Continued

Mine Lingan
Location 10 East Bottom
Sample ID Pail #7
Date 01/28/87

Moisture % 1.06
Ash % 4.43
Sample Mass (grms)(m) 18643
Factor (f) 0.9451
Mining Time 05:31:30
Sealing Time 05:33:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G Vol cc STP	H Flow cc/Min (G/L)	I Corrected Flow cc/Min	J CH4 M3/Ton (L*I)/(m*f)	K Cumulative M3/Ton	L Time Increment min	M Cumulative Time Min
01/28/87	06:00:00	19.00	805	43.430	55	49	49	49	0.0028	0.1420	1.00	28.50
01/28/87	06:02:00	19.00	805	43.476	46	41	20	21	0.0023	0.1444	2.00	30.50
01/28/87	06:03:00	19.00	805	43.518	42	37	37	38	0.0021	0.1465	1.00	31.50
01/28/87	06:04:00	19.00	805	43.556	38	34	34	34	0.0019	0.1484	1.00	32.50
01/28/87	06:05:00	19.00	805	43.598	42	37	37	38	0.0021	0.1506	1.00	33.50
01/28/87	06:06:00	19.00	805	43.636	38	34	34	34	0.0019	0.1525	1.00	34.50
01/28/87	06:07:00	19.00	805	43.678	42	37	37	38	0.0021	0.1546	1.00	35.50
01/28/87	06:08:00	19.00	805	43.727	49	43	43	44	0.0025	0.1571	1.00	36.50
01/28/87	06:09:00	19.00	805	43.788	61	54	54	55	0.0031	0.1602	1.00	37.50
01/28/87	06:10:00	19.00	805	43.845	57	50	50	51	0.0029	0.1631	1.00	38.50
01/28/87	06:11:00	19.00	805	43.900	55	49	49	49	0.0028	0.1659	1.00	39.50
01/28/87	06:12:00	19.00	805	43.947	47	41	41	42	0.0024	0.1683	1.00	40.50
01/28/87	06:13:00	19.00	805	43.990	43	38	38	39	0.0022	0.1705	1.00	41.50
01/28/87	06:14:00	19.00	805	44.036	46	41	41	41	0.0023	0.1728	1.00	42.50
01/28/87	06:15:00	19.00	805	44.080	44	39	39	39	0.0022	0.1751	1.00	43.50
01/28/87	06:16:00	19.00	805	44.129	49	43	43	44	0.0025	0.1776	1.00	44.50
01/28/87	06:17:00	19.00	805	44.178	49	43	43	44	0.0025	0.1801	1.00	45.50
01/28/87	06:18:00	19.00	805	44.262	84	74	74	75	0.0043	0.1843	1.00	46.50
01/28/87	06:19:00	19.00	805	44.311	49	43	43	44	0.0025	0.1868	1.00	47.50
01/28/87	06:20:00	19.00	805	44.368	57	50	50	51	0.0029	0.1897	1.00	48.50
01/28/87	06:21:00	19.00	805	44.410	42	37	37	38	0.0021	0.1919	1.00	49.50
01/28/87	06:22:00	19.00	805	44.458	48	42	42	43	0.0024	0.1943	1.00	50.50

Table 6 - Continued

Mine Lingan
Location 10 East Bottom
Sample ID Pail #7
Date 01/28/87

Moisture % 1.06
Ash % 4.43
Sample Mass (grms)(m) 18643
Factor (f) 0.9451
Mining Time 05:31:30
Sealing Time 05:33:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G Vol cc STP	H Flow cc/Min (G/L)	I Corrected Flow cc/Min	J CH4 M3/Ton (L*I)/(m*f)	K Cumulative M3/Ton	L Time Increment min	M Cumulative Time Min
01/28/87	06:23:00	19.00	805	44.500	42	37	37	38	0.0021	0.1964	1.00	51.50
01/28/87	06:24:00	19.00	806	44.549	49	43	43	44	0.0025	0.1989	1.00	52.50
01/28/87	06:25:00	19.00	806	44.590	41	36	36	37	0.0021	0.2010	1.00	53.50
01/28/87	06:26:00	19.00	806	44.640	50	44	44	45	0.0025	0.2035	1.00	54.50
01/28/87	06:28:00	19.00	806	44.730	90	79	40	40	0.0046	0.2081	2.00	56.50
01/28/87	06:29:00	19.00	806	44.770	40	35	35	36	0.0020	0.2102	1.00	57.50
01/28/87	06:30:00	19.00	806	44.805	35	31	31	31	0.0018	0.2119	1.00	58.50
01/28/87	06:32:00	19.00	806	44.871	66	58	29	30	0.0034	0.2153	2.00	60.50
01/28/87	06:36:00	19.00	806	45.015	144	127	32	32	0.0073	0.2226	4.00	64.50
01/28/87	06:37:00	19.00	806	45.062	47	41	41	42	0.0024	0.2250	1.00	65.50
01/28/87	06:40:00	19.00	806	45.190	128	113	38	38	0.0065	0.2315	3.00	68.50
01/28/87	06:42:00	19.00	806	45.239	49	43	22	22	0.0025	0.2340	2.00	70.50
01/28/87	06:44:00	19.00	806	45.287	48	42	21	22	0.0024	0.2364	2.00	72.50
01/28/87	06:46:00	19.00	806	45.328	41	36	18	18	0.0021	0.2385	2.00	74.50
01/28/87	06:48:00	19.00	806	45.390	62	55	27	28	0.0032	0.2417	2.00	76.50
01/28/87	06:50:00	19.00	806	45.411	21	19	9	9	0.0011	0.2428	2.00	78.50
01/28/87	06:52:00	19.00	806	45.455	44	39	19	20	0.0022	0.2450	2.00	80.50
01/28/87	06:54:00	19.00	806	45.499	44	39	19	20	0.0022	0.2473	2.00	82.50
01/28/87	06:56:00	19.00	806	45.546	47	41	21	21	0.0024	0.2497	2.00	84.50
01/28/87	06:58:00	19.00	806	45.592	46	41	20	21	0.0023	0.2520	2.00	86.50
01/28/87	07:00:00	19.00	806	45.641	49	43	22	22	0.0025	0.2545	2.00	88.50
01/28/87	07:02:00	19.00	806	45.692	51	45	22	23	0.0026	0.2571	2.00	90.50

Table 6 - Continued

Mine Lingan
Location 10 East Bottom
Sample ID Pail #7
Date 01/28/87

Moisture % 1.06
Ash % 4.43
Sample Mass (grms)(m) 18643
Factor (f) 0.9451
Mining Time 05:31:30
Sealing Time 05:33:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G Vol cc STP	H Flow cc/Min (G/L)	I Corrected Flow cc/Min	J CH4 M3/Ton (L*I)/(m*f)	K Cumulative M3/Ton	L Time Increment min	M Cumulative Time Min
01/28/87	07:04:00	19.00	806	45.740	48	42	21	22	0.0024	0.2595	2.00	92.50
01/28/87	07:06:00	19.00	806	45.781	41	36	18	18	0.0021	0.2616	2.00	94.50
01/28/87	07:08:00	19.00	806	45.823	42	37	19	19	0.0021	0.2638	2.00	96.50
01/28/87	07:11:00	19.00	806	45.892	69	61	20	21	0.0035	0.2673	3.00	99.50
01/28/87	07:13:00	19.00	806	45.938	46	41	20	21	0.0023	0.2696	2.00	101.50
01/28/87	07:15:00	19.00	806	45.975	37	33	16	17	0.0019	0.2715	2.00	103.50
01/28/87	07:17:00	19.00	806	46.031	56	49	25	25	0.0029	0.2744	2.00	105.50
01/28/87	07:19:00	19.00	806	46.089	58	51	26	26	0.0030	0.2773	2.00	107.50
01/28/87	07:22:00	19.00	806	46.171	82	72	24	25	0.0042	0.2815	3.00	110.50
01/28/87	07:24:00	19.00	806	46.220	49	43	22	22	0.0025	0.2840	2.00	112.50
01/28/87	07:26:00	19.00	806	46.277	57	50	25	26	0.0029	0.2869	2.00	114.50
01/28/87	07:28:00	19.00	806	46.355	78	69	34	35	0.0040	0.2909	2.00	116.50
01/28/87	07:30:00	19.00	806	46.390	35	31	15	16	0.0018	0.2927	2.00	118.50
01/28/87	07:32:00	19.00	806	46.447	57	50	25	26	0.0029	0.2956	2.00	120.50
01/28/87	07:34:00	19.00	806	46.500	53	47	23	24	0.0027	0.2983	2.00	122.50
01/28/87	07:36:00	19.00	806	46.542	42	37	19	19	0.0021	0.3004	2.00	124.50
01/28/87	07:38:00	19.00	806	46.582	40	35	18	18	0.0020	0.3024	2.00	126.50
01/28/87	07:40:00	19.00	806	46.622	40	35	18	18	0.0020	0.3045	2.00	128.50
01/28/87	07:42:00	19.00	806	46.668	46	41	20	21	0.0023	0.3068	2.00	130.50
01/28/87	07:44:00	19.00	806	46.708	40	35	18	18	0.0020	0.3089	2.00	132.50
01/28/87	07:46:00	19.00	806	46.748	40	35	18	18	0.0020	0.3109	2.00	134.50
01/28/87	07:48:00	19.00	806	46.789	41	36	18	18	0.0021	0.3130	2.00	136.50

Table 6 - Continued

Mine Lingan
Location 10 East Bottom
Sample ID Pail #7
Date 01/28/87

Moisture % 1.06
Ash % 4.43
Sample Mass (grms)(m) 18643
Factor (f) 0.9451
Mining Time 05:31:30
Sealing Time 05:33:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G Vol cc STP	H Flow cc/Min (G/L)	I Corrected Flow cc/Min	J CH4 M3/Ton (L*I)/(m*f)	K Cumulative M3/Ton	L Time Increment min	M Cumulative Time Min
01/28/87	07:50:00	19.00	806	46.835	46	41	20	21	0.0023	0.3153	2.00	138.50
01/28/87	07:52:00	19.00	806	46.885	50	44	22	22	0.0025	0.3179	2.00	140.50
01/28/87	07:54:00	19.00	806	46.935	50	44	22	22	0.0025	0.3204	2.00	142.50
01/28/87	07:56:00	19.00	806	46.975	40	35	18	18	0.0020	0.3225	2.00	144.50
01/28/87	07:58:00	19.00	806	47.008	33	29	15	15	0.0017	0.3242	2.00	146.50
01/28/87	08:00:00	19.00	806	47.040	32	28	14	14	0.0016	0.3258	2.00	148.50
01/28/87	08:02:00	19.00	806	47.069	29	26	13	13	0.0015	0.3273	2.00	150.50
01/28/87	08:04:00	19.00	806	47.098	29	26	13	13	0.0015	0.3288	2.00	152.50
01/28/87	08:06:00	19.00	806	47.120	22	19	10	10	0.0011	0.3299	2.00	154.50
01/28/87	08:08:00	19.00	806	47.143	23	20	10	10	0.0012	0.3311	2.00	156.50
01/28/87	08:10:00	19.00	806	47.168	25	22	11	11	0.0013	0.3323	2.00	158.50
01/28/87	08:12:00	19.00	806	47.190	22	19	10	10	0.0011	0.3335	2.00	160.50
01/28/87	08:15:00	19.00	806	47.231	41	36	12	12	0.0021	0.3356	3.00	163.50
01/28/87	08:18:00	19.00	806	47.268	37	33	11	11	0.0019	0.3375	3.00	166.50
01/28/87	08:21:00	19.00	806	47.309	41	36	12	12	0.0021	0.3396	3.00	169.50
01/28/87	08:24:00	19.00	0	47.330								

Table 7 - Field trial for pail #8

Mine Lingan
Location 10 East Bottom
Sample ID Pail #8
Date 11/03/87

Moisture %	1.06
Ash %	6.7
Sample mass (grms)(m)	14613
Factor (f)	0.9224
Mining Time	05:00:00
Sealing Time	05:02:30

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G Vol cc STP	H Flow cc/Min (G/L)	I Corrected Flow cc/Min	J CH4 M3/Ton (I*L)/(m*f)	K Cumulative M3/Ton	L Time Increment Min	M Cumulative Time Min
03/11/87	05:02:30	Initial reading->		48.079			Estimated Value->		0.0164	0.0164	2.50	2.50
03/11/87	05:05:00	19.50	821	48.245	166	143	57	58	0.0108	0.0272	2.50	5.00
03/11/87	05:06:30	19.50	821	48.347	102	88	59	60	0.0066	0.0339	1.50	6.50
03/11/87	05:08:00	19.50	821	48.442	95	82	55	56	0.0062	0.0400	1.50	8.00
03/11/87	05:09:00	19.50	821	48.510	68	59	59	60	0.0044	0.0445	1.00	9.00
03/11/87	05:10:00	19.50	821	48.575	65	56	56	57	0.0042	0.0487	1.00	10.00
03/11/87	05:11:30	19.50	821	48.685	110	95	63	64	0.0071	0.0558	1.50	11.50
03/11/87	05:13:00	19.50	821	48.764	79	68	45	46	0.0051	0.0610	1.50	13.00
03/11/87	05:14:00	19.50	821	48.815	51	44	44	45	0.0033	0.0643	1.00	14.00
03/11/87	05:15:00	19.50	821	48.855	40	35	35	35	0.0026	0.0669	1.00	15.00
03/11/87	05:16:00	19.50	821	48.899	44	38	38	39	0.0029	0.0698	1.00	16.00
03/11/87	05:17:00	19.50	821	48.938	39	34	34	34	0.0025	0.0723	1.00	17.00
03/11/87	05:18:00	19.50	821	48.980	42	36	36	37	0.0027	0.0750	1.00	18.00
03/11/87	05:19:00	19.50	821	49.024	44	38	38	39	0.0029	0.0779	1.00	19.00
03/11/87	05:21:00	19.50	821	49.128	104	90	45	46	0.0068	0.0847	2.00	21.00
03/11/87	05:23:00	19.50	821	49.231	103	89	44	45	0.0067	0.0914	2.00	23.00
03/11/87	05:25:00	19.50	821	49.318	87	75	38	38	0.0057	0.0970	2.00	25.00
03/11/87	05:27:00	19.50	821	49.396	78	67	34	34	0.0051	0.1021	2.00	27.00
03/11/87	05:29:00	19.50	821	49.470	74	64	32	32	0.0048	0.1069	2.00	29.00
03/11/87	05:31:00	19.50	821	49.558	88	76	38	39	0.0057	0.1126	2.00	31.00
03/11/87	05:33:00	19.50	821	49.640	82	71	35	36	0.0053	0.1180	2.00	33.00
03/11/87	05:35:00	19.50	821	49.719	79	68	34	35	0.0051	0.1231	2.00	35.00

Table 7 - Continued

Mine Lingan
Location 10 East Bottom
Sample ID Pail #8
Date 11/03/87

Moisture %	1.06
Ash %	6.7
Sample mass (grms)(m)	14613
Factor (f)	0.9224
Mining Time	05:00:00
Sealing Time	05:02:30

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G Vol cc STP	H Flow cc/Min (G/L)	I Corrected Flow cc/Min	J CH4 M3/Ton (I*L)/(m*f)	K Cumulative M3/Ton	L Time Increment Min	M Cumulative Time Min
03/11/87	05:38:00	19.50	821	49.794	75	65	22	22	0.0049	0.1280	3.00	38.00
03/11/87	05:40:00	19.50	821	49.911	117	101	51	51	0.0076	0.1356	2.00	40.00
03/11/87	05:42:00	19.50	821	50.000	89	77	38	39	0.0058	0.1414	2.00	42.00
03/11/87	05:45:00	19.50	821	50.072	72	62	21	21	0.0047	0.1461	3.00	45.00
03/11/87	05:48:00	19.50	821	50.156	84	73	24	25	0.0055	0.1516	3.00	48.00
03/11/87	05:51:00	19.50	821	50.225	69	60	20	20	0.0045	0.1561	3.00	51.00
										0.167		60
03/11/87	06:17:00	19.00	821	50.780	555	480	18	19	0.0363	0.1924	26.00	77.00
03/11/87	06:20:00	19.00	821	50.834	54	47	16	16	0.0035	0.1959	3.00	80.00
03/11/87	06:23:00	19.00	821	50.911	77	67	22	23	0.0050	0.2009	3.00	83.00
03/11/87	06:26:00	19.00	821	50.980	69	60	20	20	0.0045	0.2054	3.00	86.00
03/11/87	06:29:00	19.00	821	51.044	64	55	18	19	0.0042	0.2096	3.00	89.00
03/11/87	06:31:00	19.00	821	51.086	42	36	18	19	0.0027	0.2124	2.00	91.00
03/11/87	06:45:00	19.00	821	51.352	266	230	16	17	0.0174	0.2298	14.00	105.00

Table 8 - Field trial for pail #9

Mine Lingan
Location 10 East Bottom
Sample ID Pail #9
Date 03/11/87

Moisture %	1.48
Ash %	4.01
Sample Mass (grms)(m)	14623
Factor (f)	0.9451
Mining Time	06:43:00
Sealing Time	06:45:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G VOL cc STP	H Flow cc/Min G/L	I Corrected Flow cc/Min	J CH4 M3/Ton (I*L)/(m*f)	K Cumulative M3/Ton	L Time Increment Min	M Cumulative Time Min
03/11/87	06:45:30	Initial reading->		251.435			Estimated value->		0.0404	0.0404	2.00	2.00
03/11/87	06:47:00	19.00	823	251.595	160	138	92	93	0.0100	0.0503	1.50	3.50
03/11/87	06:48:00	19.00	823	251.717	122	105	105	107	0.0076	0.0580	1.00	4.50
03/11/87	06:49:00	19.00	823	251.812	95	82	82	83	0.0059	0.0639	1.00	5.50
03/11/87	06:50:00	19.00	823	251.900	88	76	76	77	0.0055	0.0694	1.00	6.50
03/11/87	06:51:00	19.00	823	251.975	75	65	65	66	0.0047	0.0741	1.00	7.50
03/11/87	06:52:00	19.00	823	252.047	72	62	62	63	0.0045	0.0786	1.00	8.50
03/11/87	06:53:00	19.00	823	252.118	71	61	61	62	0.0044	0.0830	1.00	9.50
03/11/87	06:54:00	19.00	823	252.198	80	69	69	70	0.0050	0.0880	1.00	10.50
03/11/87	06:55:00	19.00	823	252.268	70	60	60	61	0.0044	0.0924	1.00	11.50
03/11/87	06:56:00	19.00	823	252.330	62	53	53	54	0.0039	0.0962	1.00	12.50
03/11/87	06:57:00	19.00	823	252.389	59	51	51	52	0.0037	0.0999	1.00	13.50
03/11/87	06:58:00	19.00	823	252.434	45	39	39	39	0.0028	0.1027	1.00	14.50
03/11/87	06:59:00	19.00	823	252.478	44	38	38	39	0.0027	0.1055	1.00	15.50
03/11/87	07:00:00	19.00	823	252.520	42	36	36	37	0.0026	0.1081	1.00	16.50
03/11/87	07:03:00	19.00	823	252.684	164	142	47	48	0.0102	0.1183	3.00	19.50
03/11/87	07:05:00	19.00	823	252.800	116	100	50	51	0.0072	0.1256	2.00	21.50
03/11/87	07:07:00	19.00	823	252.905	105	91	45	46	0.0066	0.1321	2.00	23.50
03/11/87	07:09:00	19.00	823	252.999	94	81	41	41	0.0059	0.1380	2.00	25.50
03/11/87	07:11:00	19.00	823	253.090	91	79	39	40	0.0057	0.1437	2.00	27.50
03/11/87	07:13:00	19.00	823	253.180	90	78	39	39	0.0056	0.1493	2.00	29.50
03/11/87	07:16:00	19.00	823	253.300	120	104	35	35	0.0075	0.1568	3.00	32.50

Table 8 - Continued

Mine Lingan
Location 10 East Bottom
Sample ID Pail #9
Date 03/11/87

Moisture %	1.48
Ash %	4.01
Sample Mass (grms)(m)	14623
Factor (f)	0.9451
Mining Time	06:43:00
Sealing Time	06:45:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E DTM Reading L	F Gas Vol cc	G VOL cc STP	H Flow cc/Min G/L	I Corrected Flow cc/Min	J CH4 M3/Ton (I*L)/(m*f)	K Cumulative M3/Ton	L Time Increment Min	M Cumulative Time Min
03/11/87	07:19:00	19.00	823	253.404	104	90	30	30	0.0065	0.1633	3.00	35.50
03/11/87	07:22:00	19.00	823	253.500	96	83	28	28	0.0060	0.1693	3.00	38.50
03/11/87	07:26:00	19.00	823	253.590	90	78	19	20	0.0056	0.1749	4.00	42.50
03/11/87	07:28:00	19.00	823	253.630	40	35	17	18	0.0025	0.1774	2.00	44.50
03/11/87	07:30:00	19.00	823	253.674	44	38	19	19	0.0027	0.1802	2.00	46.50
03/11/87	07:32:00	19.00	823	253.710	36	31	16	16	0.0022	0.1824	2.00	48.50
03/11/87	07:34:00	19.00	823	253.742	32	28	14	14	0.0020	0.1844	2.00	50.50
03/11/87	07:36:00	19.00	823	253.780	38	33	16	17	0.0024	0.1868	2.00	52.50
03/11/87	07:38:00	19.00	823	253.809	29	25	13	13	0.0018	0.1886	2.00	54.50
03/11/87	07:40:00	19.00	823	253.840	31	27	13	14	0.0019	0.1905	2.00	56.50
03/11/87	07:42:00	19.00	823	253.870	30	26	13	13	0.0019	0.1924	2.00	58.50
03/11/87	07:45:00	19.00	823	253.917	47	41	14	14	0.0029	0.1953	3.00	61.50
03/11/87	07:48:00	19.00	823	253.958	41	35	12	12	0.0026	0.1979	3.00	64.50

Table 9 - Field trial for sample #4 (water displacement example)

Mine	Lingan	Moisture %	1.02
Location	6 West Jack 119	Ash %	1.70
Sample ID	Canister #4	Sample Mass (grms)(m)	1398.3
Date	10/08/86	Factor (f)	0.9758
		Mining Time	10:15:00
		Sealing Time	10:15:00

A Date	B Measurement Time	C Temp Celcius	D BP mm Hg	E Gas Vol cc	F VOL cc STP	G CH4 M3/Ton F/(m*f)	H Cumulative M3/Ton	J Time Increment Min	K Cumulative Time Min
10/08/86	10:15:00	23.3	798				0.0000	0.00	0.00
10/08/86	10:25:00	23.3	798	54	47	0.0348	0.0348	10.00	10.00
10/08/86	10:35:00	23.3	798	44	39	0.0284	0.0632	10.00	20.00
10/08/86	10:45:00	23.3	799	35	31	0.0228	0.0860	10.00	30.00
10/08/86	10:55:00	23.9	799	29	25	0.0185	0.1045	10.00	40.00
10/08/86	11:05:00	23.9	799	26	22	0.0164	0.1209	10.00	50.00
10/08/86	11:15:00	23.9	799	23	20	0.0145	0.1354	10.00	60.00
10/08/86	11:25:00	23.9	799	21	18	0.0135	0.1489	10.00	70.00
10/08/86	11:35:00	23.9	798	19	16	0.0120	0.1609	10.00	80.00
10/08/86	11:45:00	23.9	798	18	16	0.0118	0.1728	10.00	90.00
10/08/86	11:55:00	23.9	798	17	15	0.0109	0.1837	10.00	100.00
10/08/86	12:05:00	23.9	798	16	14	0.0106	0.1942	10.00	110.00
10/08/86	12:15:00	23.9	798	15	13	0.0097	0.2039	10.00	120.00

During the shift, the bunker was empty and the sample was retrieved from the converyor system leading to the surface. The elapsed time of retrieval was taken from the point of spillage onto the main conveyor.

Pail #3 - This trial took place at Lingan Mine's 6 West intake gate during normal cutting (1.5-2 cuts per shift), Figure 5. The sample was taken from the small panline leading to the stageloader as the shearer approached the bottom of the wall. Conditions at the panline were wet as represented in the moisture content of the sample, Table 3.

Pail #'s 4 and 5 - This trial took place at the Phalen Mine's 1 East top level development heading, Figure 6, with cutting of coal on a regular basis. The sample was retrieved from the face area immediately after cutting and placed in two pails and measured simultaneously. The coal sample collected was very friable and broke upon handling. Testing was stopped at the 48-minute mark and is restarted at the 82-minute mark, due to a move to a new testing area.

Pail #6 - This trial took place at Lingan Mine's 6 West intake gate with sporadic cutting of the face coal (.5 cuts in 2 weeks), Figure 5. The wall face and bottom area at this time were being repaired (straightened out and roof bolted) respectively. The sample was taken from the small panline leading to the stageloader during a small pass of the shearer at the bottom of the wall.

Pail #7 - This trial took place at Lingan Mine's 10 East intake gate with normal cutting of coal (2-3 cuts per shift), Figure 5. The sample was collected from the panline in the immediate face area at the wall bottom as the shearer made its second pass to the top.

Pail #8 - This trial took place at Lingan Mine's 10 East intake gate with normal cutting of coal (2-3 cuts per shift), Figure 5.

The sample was collected from the panline in the immediate face area at the wall bottom as the shearer made its first pass.

Pail #9 - This trial took place at Lingan Mine's 10 East intake gate with normal cutting of coal (2-3 cuts per shift), Figure 5. The sample was collected from the panline in the immediate face area at the wall bottom as the shearer made its second pass to the top.

NOTE: Trials 8 and 9 occurred on the same shift with sampling times as shown in Tables 7 and 8.

CALCULATIONS - TABLES 1 TO 8

Each measured gas volume was converted to STP (273 K, 760 mm Hg) by the following equation, Tables 1 to 8 columns F & G:

$$V = Vo \times [(T + 273)/273] \times 760/P \qquad \text{Eq. 1}$$

where, V = Standardized gas volume
Vo = Measured gas volume
T = Air temperature degree celsius
P = The air pressure (mm Hg)

The standardized flow was then calculated using the next equation, Tables 1 to 8 column H:

$$SF = V/T \qquad \text{Eq. 2}$$

where, SF = Standardized flow
V = Standardized volume
T = Time between previous reading

As mentioned, the DTM was calibrated against flows obtained by a SBF, Figure 7. A best fit curve and equation was obtained using the least square method, Tables 1 to 8 column I. This curve is used to correct the SF value to standard SBF values.

$$CF = SF \times 1.015 + .11 \qquad \text{Eq. 3}$$

where, CF = Corrected flow
SF = Standardized measured flow

The new standardized volume was calculated by the following equation, Tables 1 to 8 column J:

$$SV = SF \times T \qquad \text{Eq. 4}$$

where, SV = Standardized volume
SF = Standardized flow
T = Time interval between previous reading

The mass of coal was converted to a moisture and ash free basis by the following equation:

$$Ml = Mo \times [100 - (A + M)]/100 \qquad \text{Eq. 5}$$

where, Ml = Mass of coal on a moisture and ash free basis
Mo = Original mass of coal
A = % ash content of the coal
M = % moisture content of the coal

The volume of standardized gas volume m^3/ton of moisture and ash free coal was calculated using the following equation:

$$SFT = SV/Ml \qquad \text{Eq. 6}$$

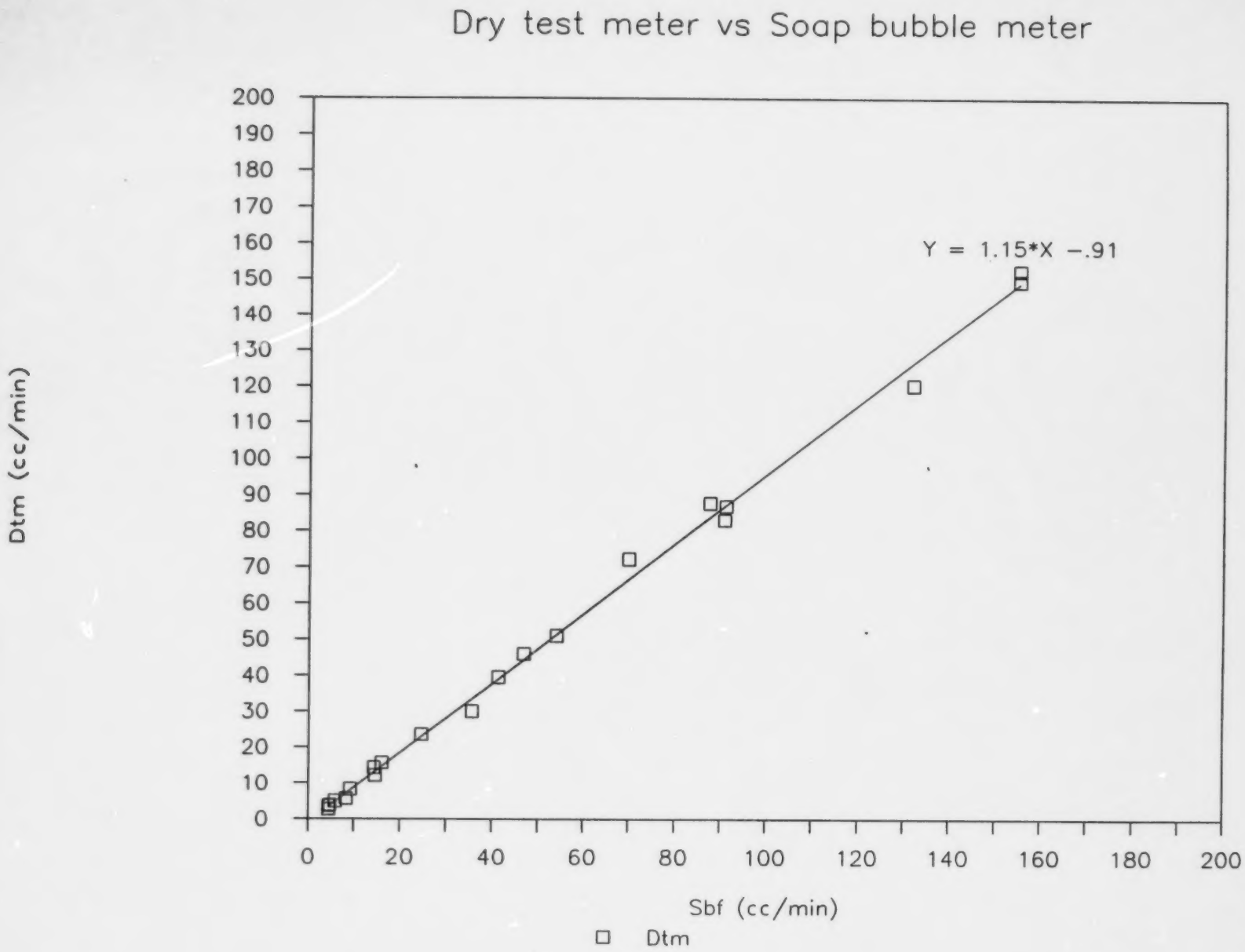


Figure 7 - Dry test meter calibration, dry test meter vs the soap bubble flowmeter

where, SGT = Standardized gas volume m^3/ton of coal
SV = Standardized gas volume (cc)
Ml = Mass of coal moisture and ash free basis (g)

NOTE: The conversion of cc/g is equivalent to m^3/ton

DETERMINATION OF LOST GAS "Q"

The method for determining gas loss was developed previously (1) and is described below.

It has been found that a plot of cumulative production of coal gas m^3/ton vs the square root of cumulative time produces a linear type plot, Figure 8. This particular example was constructed from Table 1 using columns K and M. Measurements of the flows for the first 10 minutes for each trial were used to estimate the lost gas. From this data a least square linear equation is derived with the 'y' intercept representing the gas lost from the time of mining to the sealing of the pail. Each table contains an estimated lost gas value with Table 4 containing one extra value because of the interruption of testing as described earlier.

PERCENT RELEASE OF GAS BASED ON AN AVERAGE TOTAL GAS CONTENT

Table 10 provides a summary of the percentage of gas released from the average total gas content of ROM coal. The values stated are at 15-minute time intervals up to 1 hour from the start of cutting. The exceptions are pail #2 with the percentages from time of spillage as described in the summary of sample conditions. Sample #2, not in table, was tested using a water displacement direct method (1) and is for comparison purposes only, Figure 9. The average total gas content values are a result of tests carried out using procedures described previously (2).

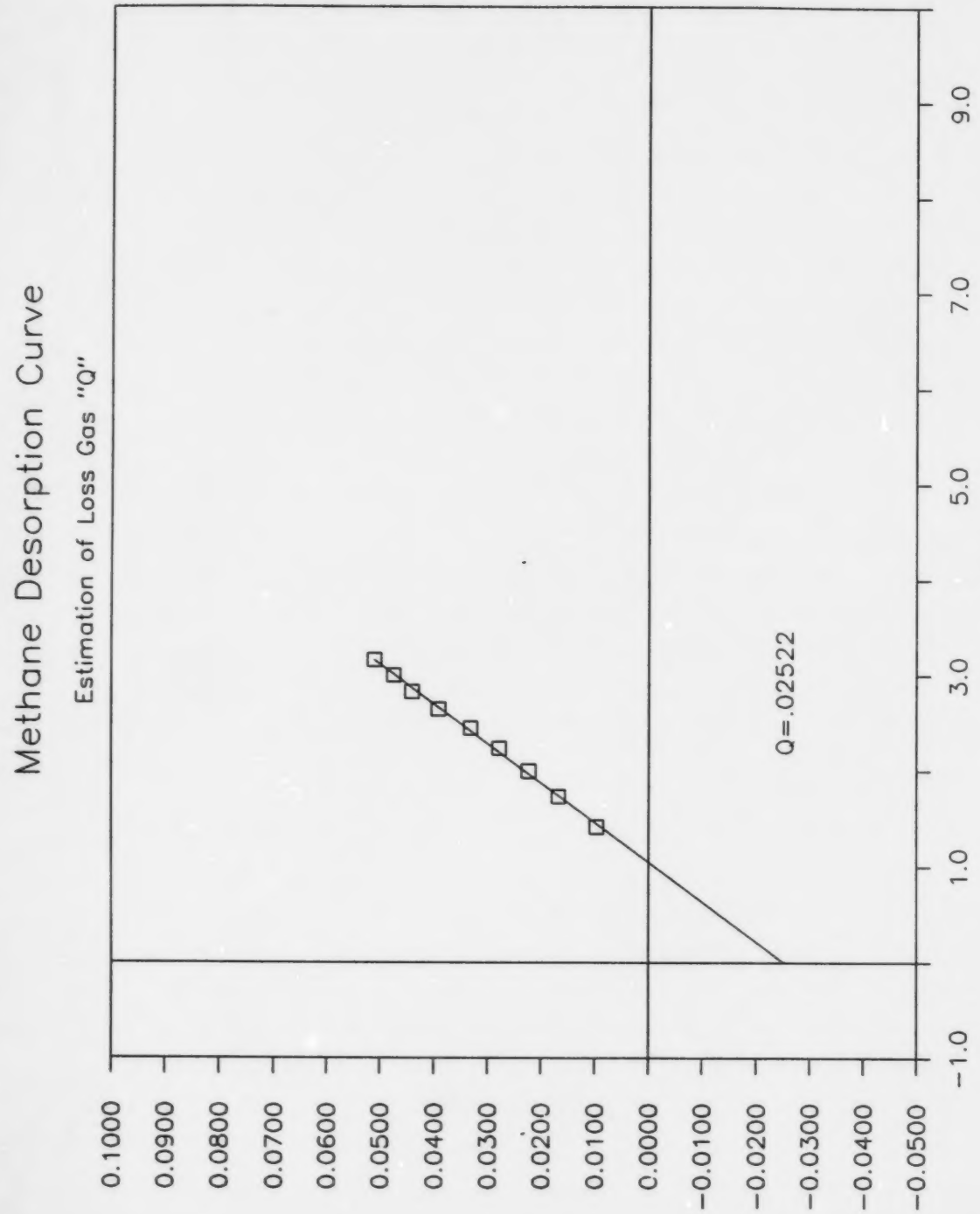


Figure 8 - Estimation of lost gas for trial 1

Table 10 - Percent release of gas based on total gas content

Sample ID		Mine	Location	Average Gas Content M3/Ton	% Released From average gas content 15 Min	30 Min	45 Min	60 Min
Pail #1	10/02/86	Phalen	#3 deep developement	6.4	1.54	2.32	2.88	3.40
Pail #2	11/06/86	Lingan	Bunker	8.2	0.70	1.09	1.40	1.70
Pail #3	11/13/86	Lingan	6 West intake gate	7.6	2.08	3.15	4.08	4.85
Pail #4&5	12/15/86	Phalen	1 East developement	6.4	0.57	0.78	1.01	1.26
Pail #6	01/22/87	Lingan	6 West intake gate	7.6	0.39	0.61	0.80	0.96
Pail #7	01/28/87	Lingan	10 East intake gate	7.8	1.18	1.82	2.33	2.74
Pail #8	03/11/87	Lingan	10 East intake gate	7.8	0.83	1.39	1.82	2.14
Pail #9	03/11/87	Lingan	10 East intake gate	7.8	1.32	1.92	2.28	2.49

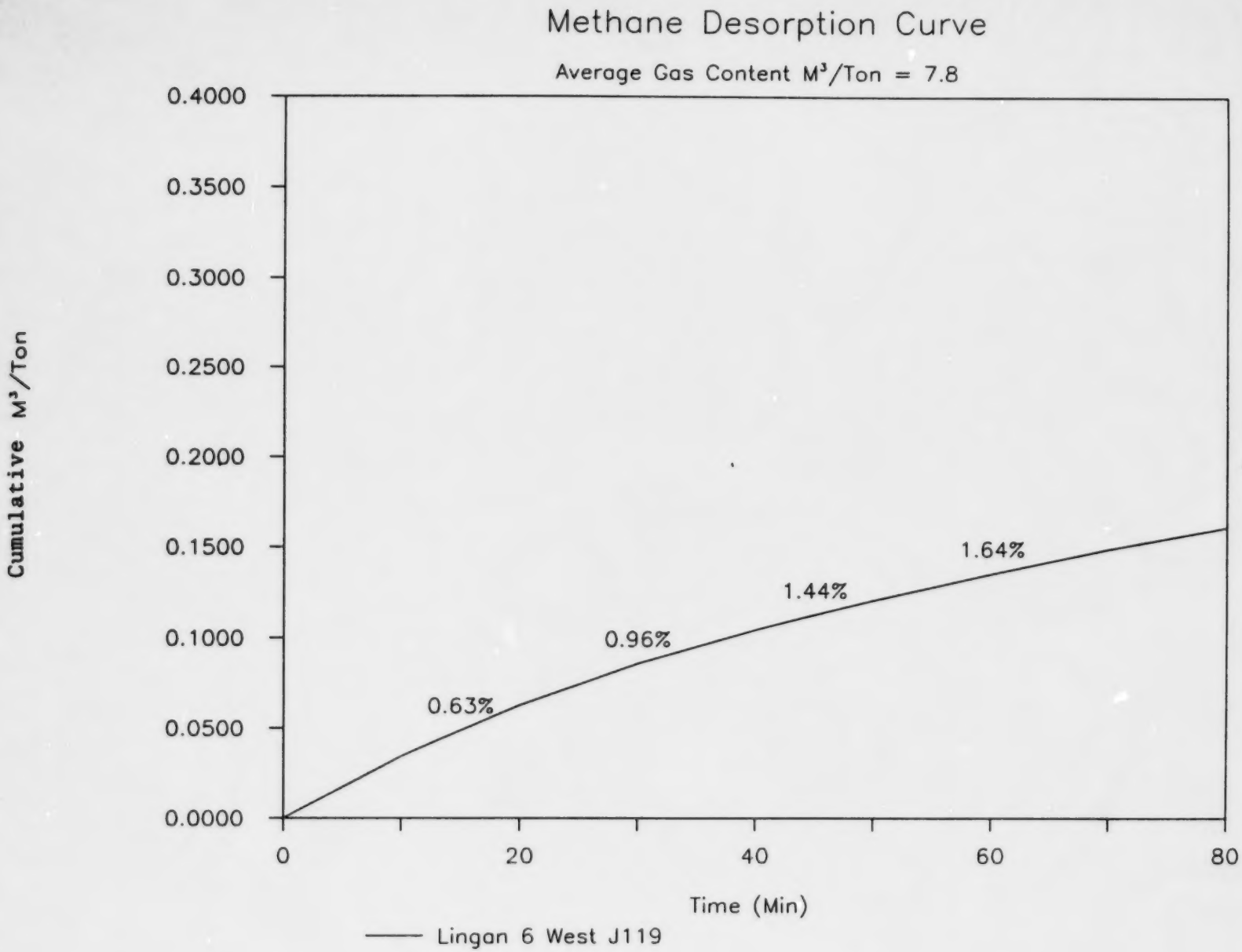


Figure 9 - Water displacement results for comparison purposes

FIELD OBSERVATIONS

On all field trials, there were variations in gas flows measured by the DTM. It was expected that the rate of gas flow would be negatively sloping, however, in many cases flows would increase. This positive variation for the most part is due to the pressure variations in the mine's ventilation system. For example, in Table 6, at the 6.19 pm mark, the gas flow rose abnormally high above previous readings. Prior to this time, it was learned that the air regulating doors had been opened in the district and caused an air pressure drop. Consequently, the relative gas output pressure from the pail increased as detected by the gauge. Occasionally, the opening and closing of these doors and other variations in air pressure may account for the abnormal variations in the gas flow rate.

GENERAL COMMENTS

Figures 10-17 show the liberation of coal gas occurring rapidly in the initial post-cutting period and then decreases slowly during the remaining time.

Table 10 shows that based on relative total gas content, the maximum amount of gas released to the mine's ventilation within one hour of mining is 5% of the average total gas content of coal. Assuming the coal is transported to the surface in one hour. Ninety-five percent (95%) of the gas remains.

It is assumed that variations in the mine's ventilation pressure and subsequent variations in coal gas flows from the sample pail average out and do not affect the overall results. However, any specific analysis of gas flows, especially in the immediate sampling period, should be treated carefully, possibly by curve fitting the best line to the flow values. Figure 18 gives a better description of gas flows from the coal sample. Finally, the minimum scale read on the DTM is 10 cc, therefore the last digit recorded is an estimation.

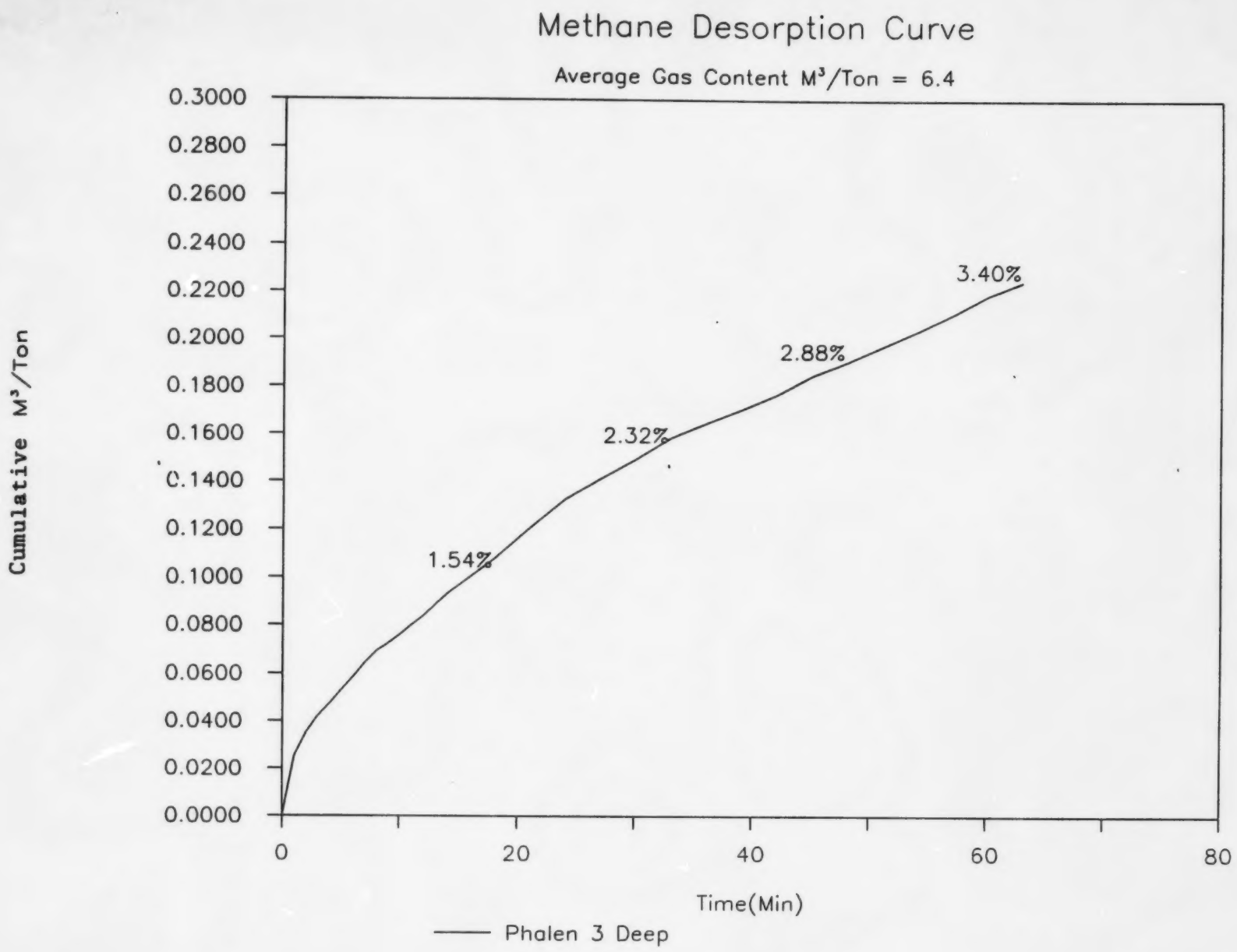


Figure 10 – Cumulative gas release m^3/ton vs time for trial 1

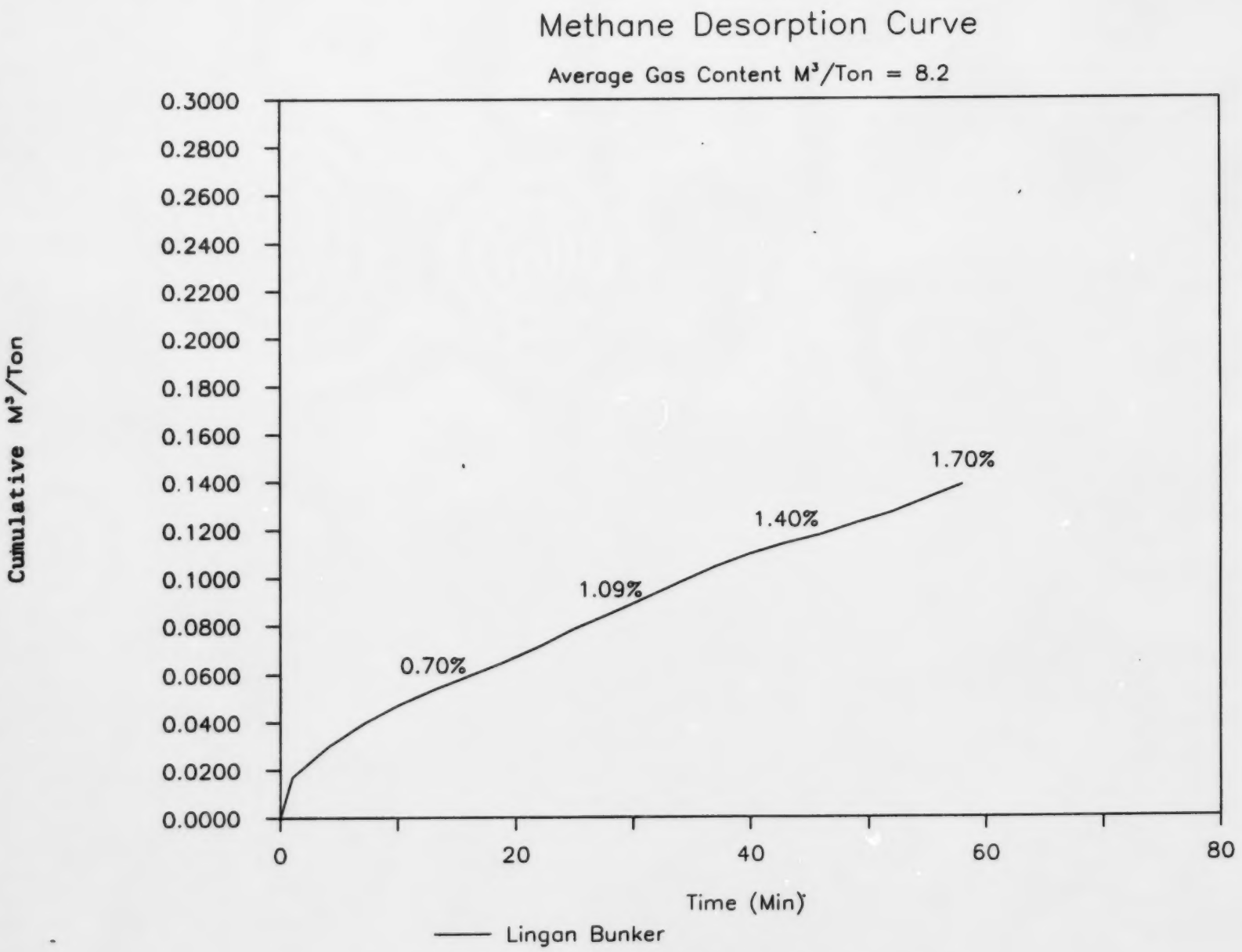


Figure 11 - Cumulative gas release m^3/ton vs time for trial 2

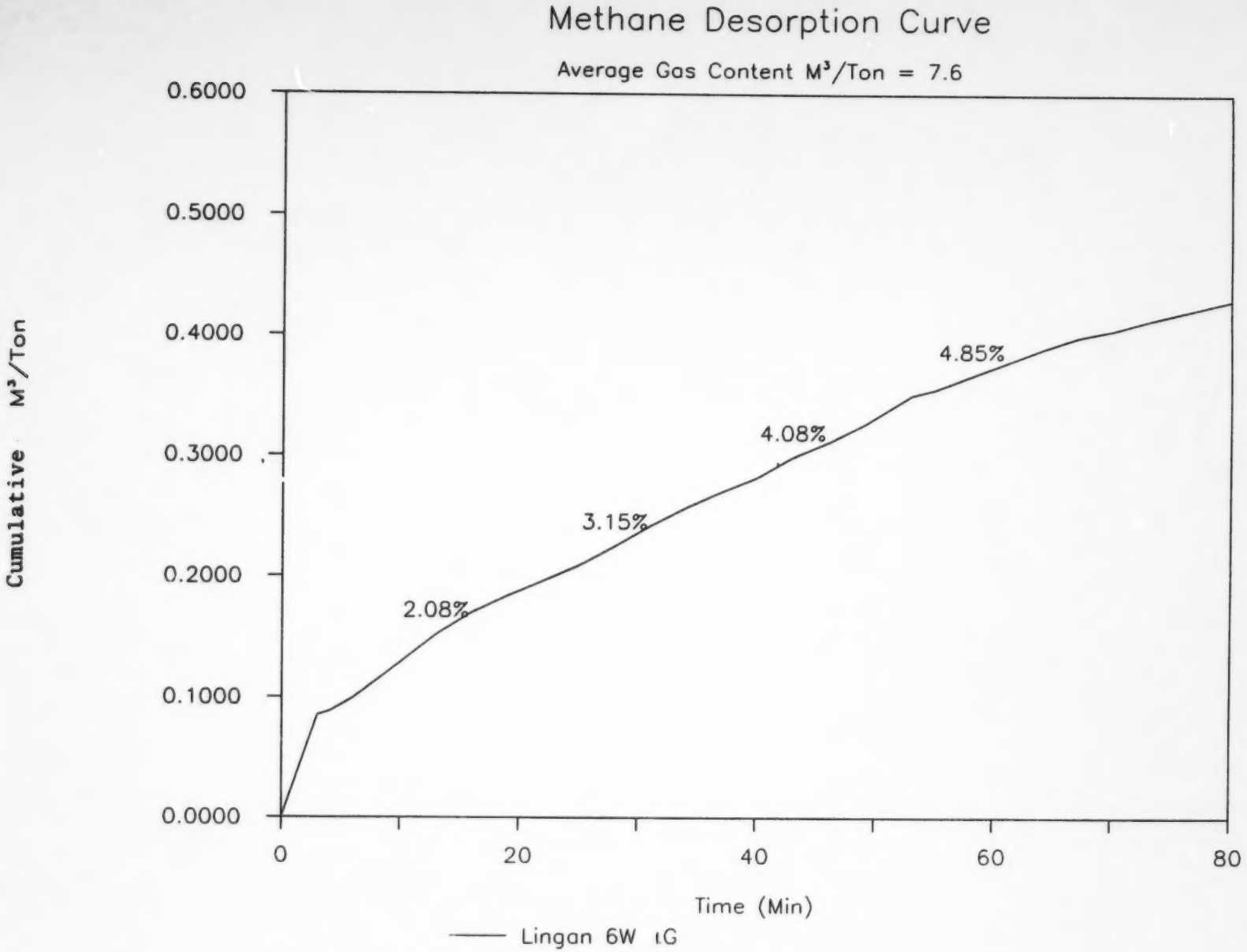


Figure 12 - Cumulative gas release m^3/ton vs time for trial 3

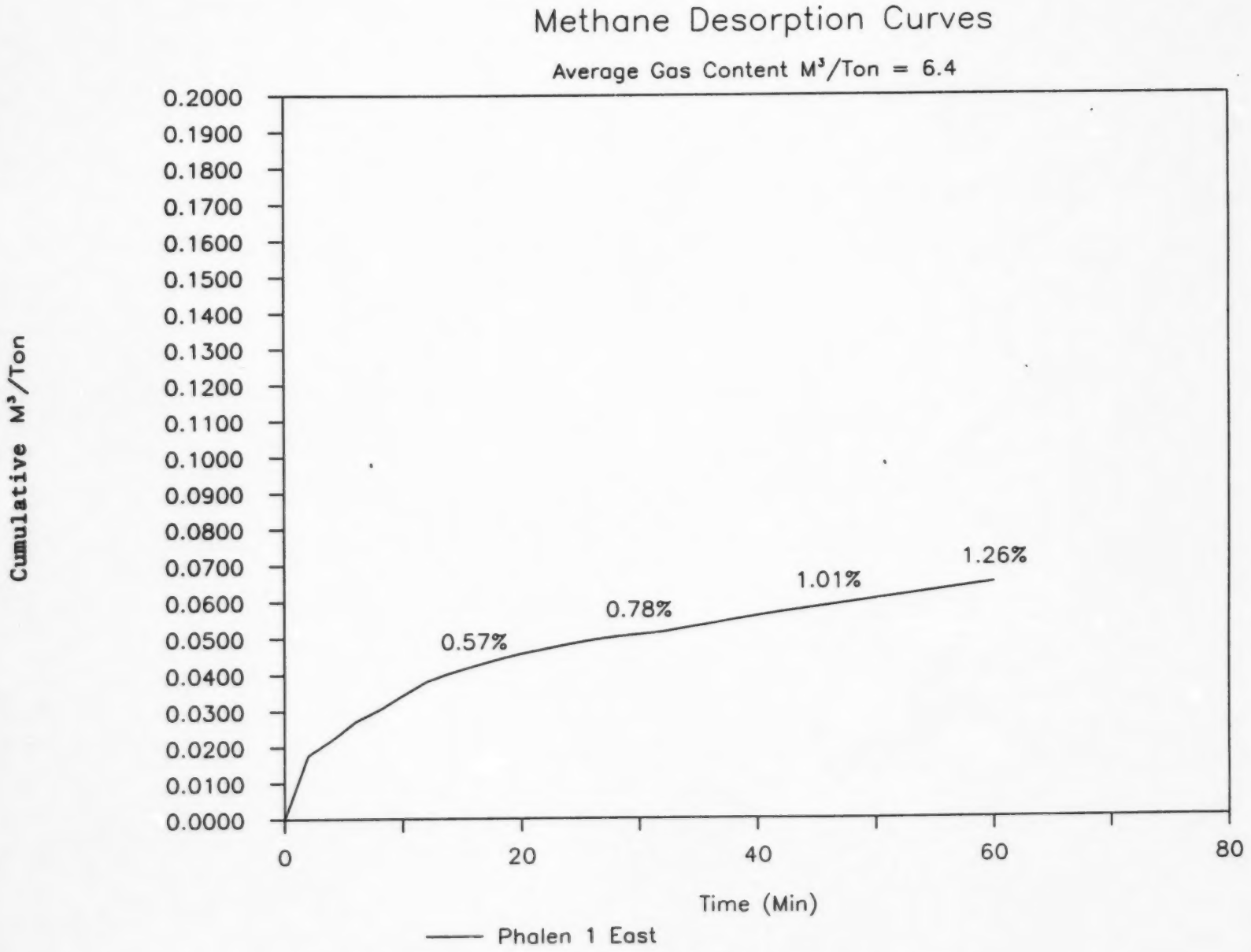


Figure 13 - Cumulative gas release m^3/ton vs time for trial 4

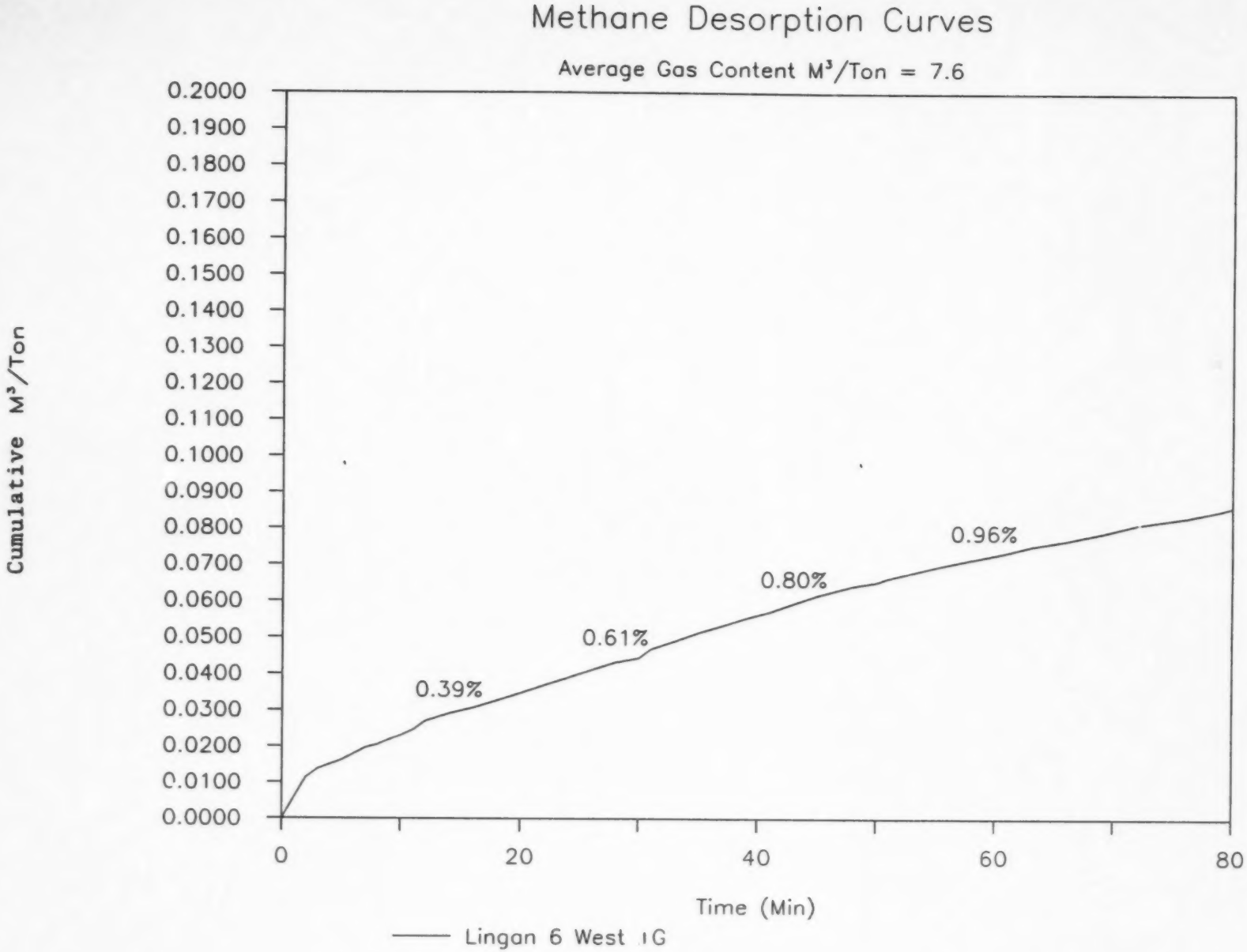


Figure 14 - Cumulative gas release m^3/ton vs time for trial 5

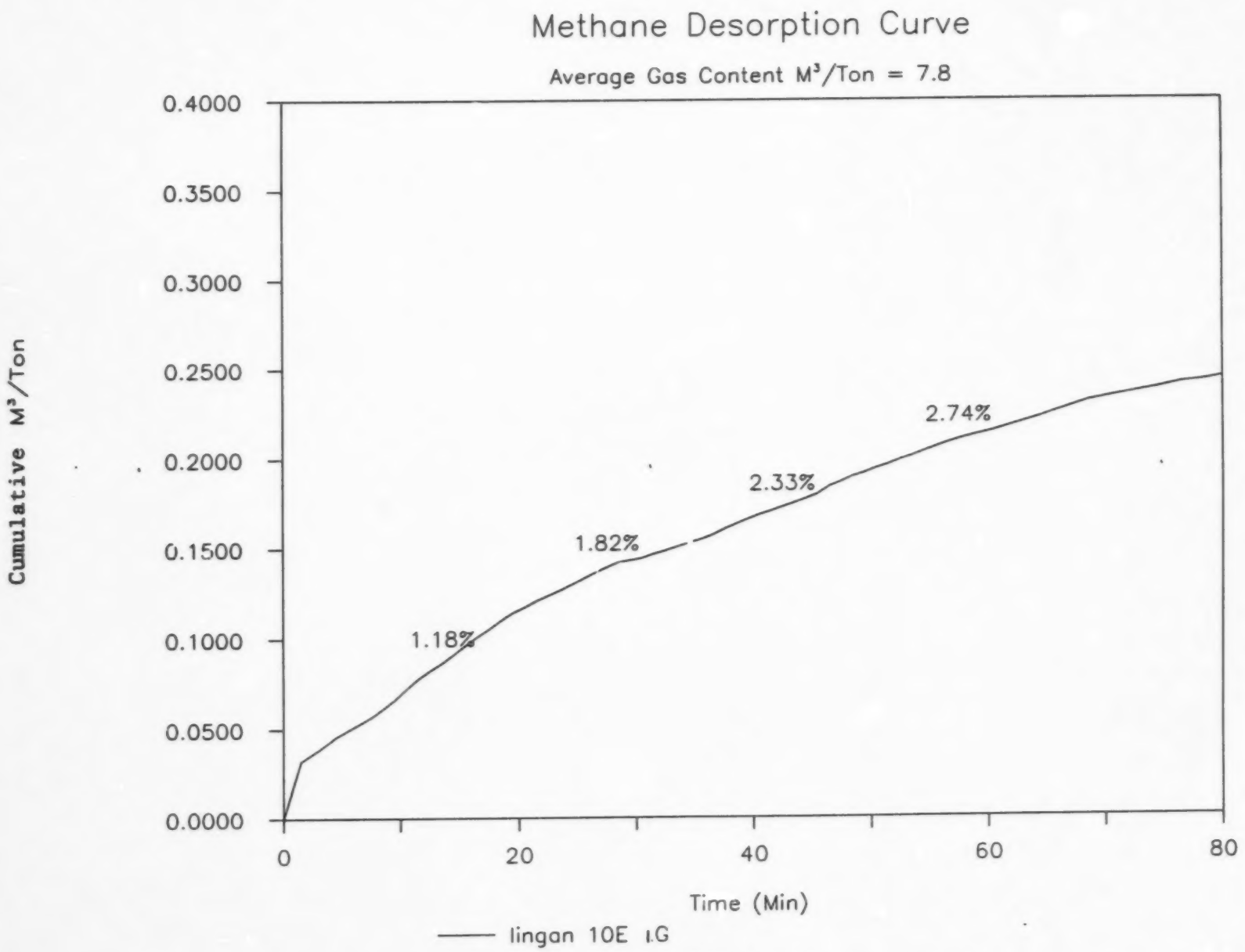


Figure 15 - Cumulative gas release m^3/ton vs time for trial 6

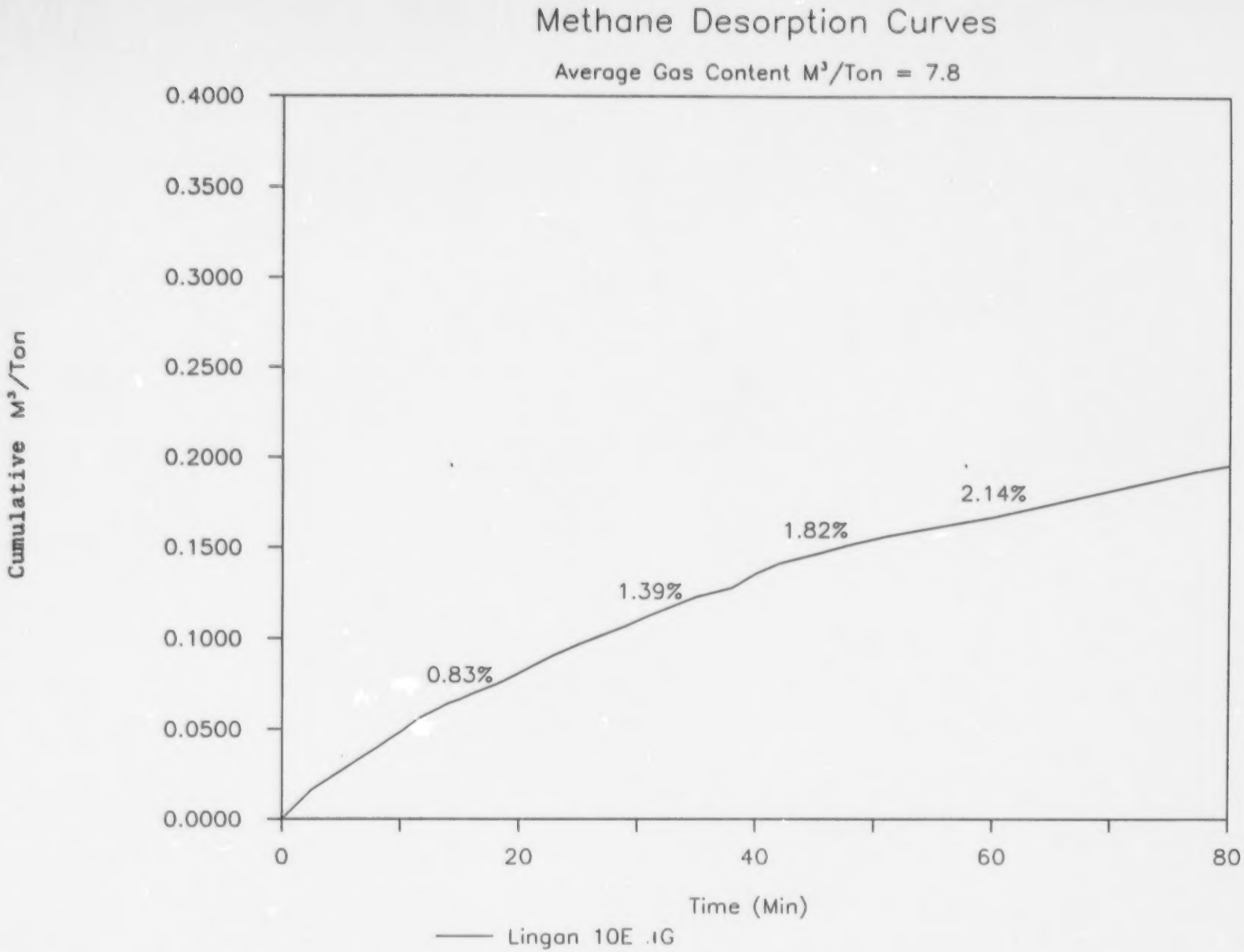


Figure 16 - Cumulative gas release m^3/ton vs time for trial 7

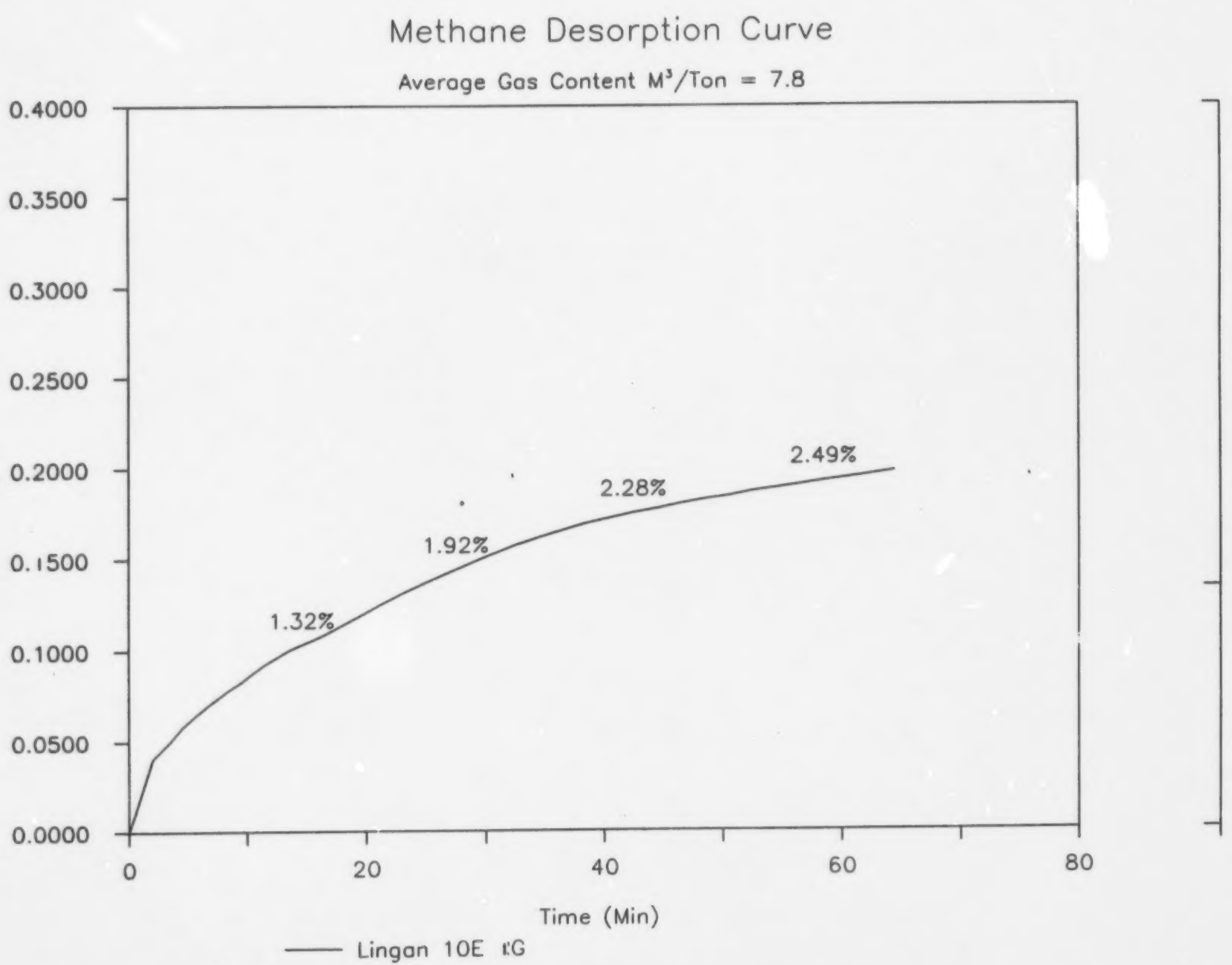


Figure 17 - Cumulative gas release m^3/ton vs time for trial 8

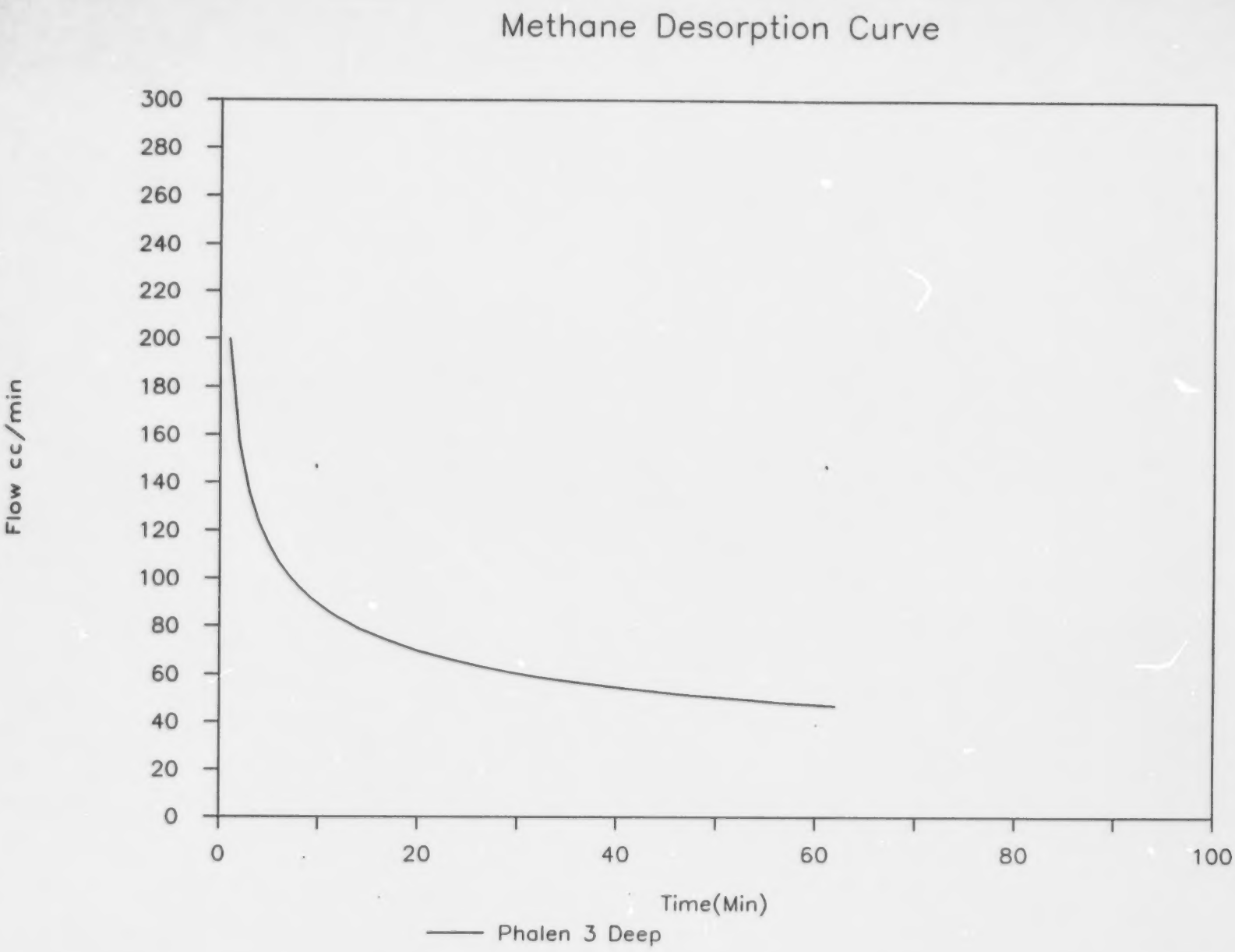


Figure 18 - Exponential fit to flows of trial #1

CONCLUSIONS

The release of coal gas from ROM coal is an important parameter to consider when trying to estimate the individual contributions to the total gas production by mining activities. The testing method provided in this report was devised to estimate the amount of coal gas released from ROM coal. The advantages of this method are as follows:

1) A continuous and uninterrupted measure of gas from ROM coal directly after mining.
2) A quantity of coal can be tested that is representative of the ROM coal.

More testing using this method is needed, including analyses of the liberated gases and screen testing of the sample coal in order to carry out a more comprehensive evaluation.

From an analysis of the gases, a more sensitive relationship can be deduced between the gas output of the pail and the concentration of methane in the gas.

Finally, a relationship between gas output, gas concentration and coal sample size must exist; therefore, it is imperative that this relationship be defined before this method can be utilized as a diagnostic tool in the studying of coal gas release from ROM.

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1. Cheng, K.C., Feng, K.K. and Augsten, R. "Test procedure for methane content of coal by direct method"; Division Report ERP/MRL 81-63(TR); August 1981.
2. Young, D.A. "A procedure for the determination of the total gas content of coal"; division report in preparation.